

**CLASS 376, INDUCED NUCLEAR REACTIONS:
PROCESSES, SYSTEMS, AND ELEMENTS****SECTION I - CLASS DEFINITION**

This class provides for patents directed to processes involving induced nuclear reactions and structures which implement such processes.

- (1) Note. For purposes of classification in this class, an induced nuclear reaction is defined as a change in the nucleus of an atom brought about by subjecting it (the nucleus) to (a) an impact with other nuclei of the same or different type, or (b) an impact with, or bombardment by, subatomic particles or high energy electromagnetic radiations.
- (2) Note. Reactions of type (a) in (1) Note, above, include those which cause or result in the combining or uniting of at least two nuclei to form a different nucleus which reactions are generally referred to as fusion reactions. Reactions of type (b) in (1) Note, above, include (1) those which cause a splitting or subdivision of the nucleus (usually a heavy nucleus) into a plurality of different nuclei and are generally referred to as fission reactions, and (2) those which result in a single but different nucleus of the same or a different element and are generally referred to as transmutations.
- (3) Note. A basis for placing a patent into this class is that a nuclear reactor be claimed or that it be utilized to obtain a nuclear reaction even though the sole or primary aim of the patent in regard to the reactor is to obtain useful nuclear energy or to utilize such nuclear energy yielding system for conversion into other forms of useful energy or power. This is true even though from a chemical view there may be nothing novel, or from an economical view, nothing of value, with respect to the products or materials resulting from the nuclear reaction.
- (4) Note. Patents to processes are not segregated from patents to the structure, but are classified together depending upon the type of structure claimed or used in the claimed process.

Included within the scope of the class are patents directed to (a) the nuclear reactor as a system of elements or parts so interrelated as to produce induced nuclear reactions and to (b) such elements or parts, per se, as are essential and peculiar components of nuclear reactors. Included among (a), for example, are neutron detectors wherein the detection takes place by means of an induced nuclear reaction. Included among (b), for example, are fuel element structures (including fuel "targets" or "pellets"), control component structures, moderator component structures, fuel element storage structures, and refueling machines.

**SECTION II - LINES WITH OTHER CLASSES
AND WITHIN THIS CLASS**

Also included in this class are the following (see Subclass References to the Current Class, below, for subclass references):

- (1) Note. Patents to processes or apparatus including a step or means for (a) converting the nucleus of a substance other than the reactor fuel to a nucleus of another substance, (b) treating or irradiating of material, or (c) making a material radioactive, all within such reactor, including for such purposes as the production of nuclear fuel or experimentation, study or research, etc.
- (2) Note. Patents to processes or apparatus including a step or means for converting the nucleus of a substance or for making a substance radioactive by bombardment with accelerated particles from a source other than a nuclear reactor.
- (3) Note. Patents directed to combination of a process or apparatus under the class definition with a step or means, e.g., (a) of cooling or heat exchange even though the purpose is to generate steam for extraneous uses, or (b) with a step or means for carrying out of a chemical reaction, etc.
- (4) Note. Patents to processes or apparatus including an arrangement of steps or means for amplifying neutrons of a subcritical mass to controllable fission reaction levels, i.e., subcritical reactors.

- (5) Note. Patents to all devices, structures, and processes for irradiating a nucleus with its antinucleus (e.g., protonantiproton) so as to produce annihilation radiation, i.e., induced matter-antimatter reaction.
- (6) Note. Patents to processes or devices that utilize a gaseous or light element fuel material, the particles of which are electrically charged or excited to the point where they become highly ionized and the forces of repulsion of like nuclei is overcome, or substantially so, wherein it is the intent of the patent that this be the result of such ionization, to the end that nuclear fusion of such like nuclei is obtained or sought to be obtained. Reactor structure in combination with any other art device is classified in this class.
- (1) Note. The line between the subject matter of this class and those classes utilizing nuclear energy reactors or reactions in an ancillary fashion for such purposes as the production of power either electrical or mechanical and for similar purposes is as follows: this class provides for claimed apparatus and processes wherein the reactor or reaction is recited either specifically or broadly and wherein structure utilizing the reactor or reaction, e.g., motor, generator, ship, aircraft, etc., is recited either specifically or broadly.
- (2) Note. Patents to processes utilizing nuclear energy to bring about chemical reactions between either inorganic or organic compounds in order to provide a different compound or product, provided neither reactor structure nor a nuclear reaction is claimed are classified elsewhere (see References to Other classes, below). Class 376, however, takes such patents if some reactor structure is claimed or if the resulting compound or product is either claimed, or is disclosed as being radioactive.
- (3) Note. This class also provides for patents to all processes and to certain devices or structures for irradiating a substance of a subject specimen or sample for research and related purposes or for making such substance radioactive. This holds true however only if the irradiation produces a transformation or similar modification of the nucleus of the substance, or if the treatment makes the substance radioactive. For other types of irradiation, see References to Other classes, below.
- (4) Note. Elements and subcombinations of nuclear reactors which may, if recited in general terms, be provided for elsewhere, are classified in this class if recited in terms of the subject matter of this class.
- (5) Note. A process of utilizing nuclear energy to bring about chemical reactions that treat or prepare a synthetic resin or rubber, provided neither nuclear reactor structure nor a nuclear reaction is claimed, is elsewhere (see References to Other Classes, below). Class 376, however, takes such patents if some reactor structure is claimed or if the resulting product is either claimed or disclosed as being radioactive.

SECTION III - SUBCLASS REFERENCES TO THE CURRENT CLASS

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 100+, for patents to processes or devices that utilize a gaseous or light element fuel material, the particles of which are electrically charged or excited to the point where they become highly ionized and the forces of repulsion of like nuclei is overcome, or substantially so, wherein it is the intent of the patent that this be the result of such ionization, to the end that nuclear fusion of such like nuclei is obtained or sought to be obtained.
- 156+, for patents to processes or apparatus including a step or means for (a) converting the nucleus of a substance other than the reactor fuel to a nucleus of another substance, (b) treating or irradiating of material, or (c) making a material radioactive, all within such reactor, including for such purposes as the production of nuclear fuel or experimentation, study or research, etc.
- 156+, patents to all devices, structures, and processes for irradiating a nucleus with its antinucleus (e.g., protonantiproton) so as to produce annihilation radiation, i.e., induced matter-antimatter reaction.
- 190+, for patents to processes or apparatus including a step or means for converting the nucleus of a

- substance or for making a substance radioactive by bombardment with accelerated particles from a source other than a nuclear reactor. See subclasses.
- 317+, for patents directed to combination of a process or apparatus under the class definition with a step or means, e.g., (a) of cooling or heat exchange even though the purpose is to generate steam for extraneous uses, or (b) with a step or means for carrying out of a chemical reaction, etc.
- 347, for patents to processes or apparatus including an arrangement of steps or means for amplifying neutrons of a subcritical mass to controllable fission reaction levels, i.e., subcritical reactors.

SECTION IV - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

- 47, Plant Husbandry, appropriate subclasses for processes of subjecting living plant or plant matter to nuclear radiation devices other than within a nuclear reactor.
- 60, Power Plants, subclass 644.1 for a power plant energized by externally applied heat in which heat directly from radioactive decay or indirectly from a nominally recited nuclear reactor is used.
- 74, Machine Element or Mechanism, appropriate subclasses for control elements, per se, (including its moving parts) except where (a) the element is structurally associated with the reactor and some reactor structure is also recited (other than in a mere broad reference to the reactor), or where (b) the control element or portion thereof is defined as being absorbing material or neutron absorbing material - patents to such elements are classified in this class (376).
- 114, Ships, appropriate subclasses for patents to ship structures utilizing nuclear reactors for power-generating purposes in which no structural elements of the nuclear reactor are claimed.
- 166, Wells, subclass 247 for well processes involving nuclear energy in general.
- 204, Chemistry: Electrical and Wave Energy, subclasses 157.2+ and 193 for processes and structure for bringing about chemical reactions by subjecting material to nuclear radiation; subclasses 157.15+ for patents to processes utilizing nuclear energy to bring about chemical reactions between either inorganic or organic compounds in order to provide a different compound or product, provided neither reactor structure nor a nuclear reaction is claimed. (See Lines With other Classes, "Reactor structure in combination with any other art device.").
- 244, Aeronautics, appropriate subclasses, particularly subclasses 53+, for patents to aircraft using a nuclear reactor as a power-generating source in which no structural elements of the nuclear reactor is claimed.
- 250, Radiant Energy, subclass 251 for molecular or atomic beam devices for producing and propagating a unidirectional stream of neutral molecules or atoms through a vacuum, usually at thermal velocities; subclasses 253+ for geological signal processing steps or apparatus involving only a nominally recited nuclear reaction; subclasses 324+ for methods and apparatus to irradiate materials by corona radiation; subclasses 390.01+ for neutron responsive means involving no induced nuclear reactions; subclasses 423+ for methods and apparatus to generate ions not involving induced nuclear reactions; subclasses 453.11+ for methods and apparatus including supports for objects to be irradiated with or without an irradiating source; subclasses 458.1+ for methods and apparatus to irradiate luminophors; subclasses 492.1+ for methods and apparatus to irradiate objects or materials generally; subclasses 493.1+ for invisible radiation generation and sources not involving induced nuclear reactions; and subclasses 505.1+ for generic storage devices for radioactive material.
- 290, Prime-Mover Dynamo Plants, appropriate subclasses for prime-mover plant using nuclear reactor as power-generating source in which no structural elements of the nuclear reactor is claimed.
- 322, Electricity: Single Generator Systems, appropriate subclasses for patents to generator systems utilizing nuclear reactors for power source in which no structural element of the nuclear reactor is claimed.
- 378, X-Ray or Gamma Ray Systems or Devices, appropriate subclasses, particularly subclass 120 for gamma ray sources.
- 424, Drug, Bio-Affecting and Body Treating Compositions, particularly subclasses 1.11+ for radionuclide containing subject matter, for: compositions (A) for preventing, alleviating, treating, or curing abnormal and pathological

- conditions of the living body, for maintaining, increasing, decreasing, limiting, or destroying a physiologic body function, for diagnosing a physiological condition or state by an in vivo test, for controlling or protecting an environment or living body by attracting, disabling, inhibiting, killing, modifying, repelling, or retarding an animal or micro-organism, (B) for deodorizing, protecting, adorning, or grooming a body, (C) for fermentates and extracts for use in A or B and not elsewhere provided for, and (D) for such compositions defined in terms of specific structure; methods of making the above compositions; methods of using the class defined compositions for purposes in A and B; and methods of using compounds, per se, for purposes in A and B.
- 426, Food or Edible Material: Processes, Compositions, and Products, subclass 240 for process of subjecting food to nuclear radiation devices other than within a nuclear reactor.
- 522, Synthetic Resins or Natural Rubbers, for a process of utilizing nuclear energy to bring about chemical reactions that treat or prepare a synthetic resin or rubber, provided neither nuclear reactor structure nor a nuclear reaction is claimed.
- 600, Surgery, subclasses 1+ for treatment of the body with radioactive substances.
- 976, Nuclear Technology, for an alternative search, based on a modification of the European Patent Office Classification.

SECTION V - GLOSSARY

Certain terms employed in this class have been assigned definitions tailored to meet the needs of this class and therefore may be more or less restricted or even altogether different from those in common usage. These terms are listed below and are flagged with an asterisk where they occur in the subclass definition that follow. The meaning to be given to the various "art" terms appearing in this class, but which have not been included in the Glossary below, is the same as that generally accepted or is in common usage.

ABSORBING MATERIAL

See Neutron Absorbing Material.

ACTIVE VOLUME

See Reactor Core.

AMPLIFICATION, NEUTRON

See Subcritical Reactor.

BLANKET MATERIAL

A layer of fertile material placed external to core of the fission reactor. See Fertile Material.

BREEDER MATERIAL

See (a) Blanket Material and (b) Fertile Material.

BURNABLE POISON

A substance with high neutron capture cross section which has a capture reaction product of low capture cross section and which is purposely put in a fission reactor to influence the long term reactivity variations.

BY-PRODUCT MATERIALS

Are nuclear reaction products (except special nuclear fuel material (see Nuclear Fuel) including gases yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear fuel in the nuclear reaction.

COMPONENT, REACTOR

For the purpose of this class, relates to any of the functional segments or parts comprising, when properly associated together, a nuclear reactor, e.g., fuel, moderator, coolant (fluid or solid), control rod, reflector, shield, etc.

CONFINEMENT PLASMA

For the purpose of this class, is either the containment or restraint force or the means (structure) for producing such force placed upon the charged particles or plasma, e.g., by electric or magnetic fields, so as to restrict said particles or plasma within a given volume.

CONTROL ELEMENT

For the purpose of this class, is rods, tubes, plates, etc., of a reactivity affecting material used to hold a fission reactor at a given power level or to vary the rate of reaction. Control elements can be given three names corresponding to three different functions, namely: (a) power control, regulating or fine control (affecting only a small change in reactivity); (b) safety or scram (capable or

reducing the reactivity below critical and used general when some emergency condition exists, such as power level to high); and (c) shim (affecting a relatively large change in reactivity of a reactor, i.e., it is used for coarse control or reactivity).

CONTROL ROD

See Control Element.

CONVERSION

For the purpose of this class, is the process of artificially bringing about a change or transformation in the nucleus of an atom. Nuclear conversion is generally caused by subjecting a material to particle bombardment, usually by neutron irradiation as happens in a fission reactor. See also Transmutation.

COOLANT

A fluid (liquid, gaseous, or particulate) whose function is to absorb heat from the reactor core and to deliver this absorbed heat to a heat exchanger or other utilization means exterior to the reactor core.

CORE, REACTOR

See Reactor Core.

CRITICAL

For the purpose of this class, is the term used to describe the condition in which a chain reaction is being maintained at a constant level, i.e., it is just self-sustaining. In order for this state to exist a sufficient quantity of fissile material (critical mass) must be assembled in the proper shape and concentration.

FAST NEUTRONS

See Thermal Neutrons.

FAST (FISSION) REACTOR

A nuclear reactor in which most of the fissions are caused by neutrons moving with substantially the high speeds they possess at the time of their birth in fission. Such reactors contain little or no moderator.

FERTILE MATERIAL

An element (isotope) capable of being readily trans-

formed or converted into a fissionable substance by capture of a neutron, examples include, U^{238} and Th^{232} .

FISSILE MATERIAL

See Fissionable Material.

FISSION

The splitting of a heavy nucleus into two (or, very rarely, more) fragments (fission products) of more or less equal mass accompanied by the emission of neutrons and the release of energy. It can be spontaneous or it can be caused by the impact of a neutron, a fast charged particle or a photon. See Fissionable Material. Cf. Spallation.

FISSIONABLE MATERIAL

Any element or isotope the nucleus of which can be caused by nuclear bombardment to undergo nuclear fission and to produce a fission chain reaction U^{233} , U^{235} , and Pu^{239} , are examples. Unless a patent refers to a distinction, "fissionable" and "fissile" are considered synonymous for the purpose of this class.

FLUIDIZED BED (FISSION) REACTOR

A reactor in which the fuel in the form of particles is maintained in a fluidized state by a fluid medium. (The fuel and the fluid are general moving in opposite directions). See subclass 355. (Includes also support of fuel in pellet form in a liquid bath by an upwardly flowing liquid).

FUEL, FUEL ELEMENT, OR FUEL COMPONENT

See Nuclear Fuel.

FULLY IONIZED

For the purpose of this class, is state in which atoms are entirely stripped of their orbital electrons for atoms of low mass number, this occurs at kinetic temperatures in the region of 1 Kev or more. In other words, matter is in a state of complete ionization; it consists of a gas composed of positively charged nuclei and an equivalent number of negative electrons with no neutral particles. See also Plasma.

FUSION

For the purpose of this class, is a nuclear reaction in

which light nuclei combine to form a nucleus of a heavier mass number. See also Thermonuclear Fusion Reaction.

HOMOGENEOUS FUEL

See Homogeneous Fission Reactor.

HOMOGENEOUS (FISSION) REACTOR

A reactor in which the fuel and moderator are intimately mixed or dispersed (e.g., the fuel may be a uranium salt dissolved in heavy water) as a solution or slurry.

INDUCED NUCLEAR REACTION

See section I, (1) Note.

INTERMEDIATE NEUTRONS

See Thermal Neutrons.

IONIZED

See (a) Fully Ionized and (b) Plasma.

MAGNETIC MIRRORS

See Mirror Field.

MIRROR FIELD

For confinement of plasma, a system has been devised whereby a longitudinal magnetic field is applied to the plasma, but instead of being uniform, the field strength is increased at spaced points. The region of enhanced magnetic field is referred to as a mirror field or magnetic mirror. Substantially all of the charged particles moving from the region of lower to that of the higher field strength, will be reflected back into the former region. This field thus acts as a sort of potential well which inhibits escape of many of the charged particles (and consequent loss of energy).

MODERATOR

For the purpose of this class, is a substance used within a fission reactor core in special relationship with the fuel to reduce the energy, and hence speed, of fast neutrons (so far as possible) emanating from the fuel by means of collisions without capturing them. Graphite and heavy water are examples.

MODERATED NEUTRONS

See Thermal Neutrons.

NEUTRON ABSORBING MATERIAL

As it relates to nuclear reactors, a substance that poses a high neutron absorption ability.

NEUTRON APLIFICATION

See Subcritical Reactor.

NUCLEAR FUEL

(a) Light elements such as hydrogen, deuterium tritium, lithium, boron beryllium, etc., which are capable of fusing or combining to form a nucleus of higher mass number, (b) fissionable fissile, or special nuclear material such as U^{233} , U^{235} , or uranium enriched with either of these Pu^{239} , etc., capable of sustaining a chain reaction.

NUCLEAR REACTION

For the purpose of this class, a change in the composition or physical characteristics of an atomic nucleus produced (a) directly or indirectly, by its irradiation or bombardment by high energy alpha particles, protons, deuterons, slow or fast neutrons or high energy radiations (gamma rays) or (b) by fusing or combining nuclei of low atomic number to produce a nucleus of higher mass number. See also class definition, section I, and (1) Note.

NUCLEAR REACTOR

For the purpose of this class, a structure inside which an induced nuclear reaction is confined, manipulated, or controlled. A nuclear fission reactor is a structure in which a fission chain reaction is a fissionable material can be maintained and controlled. Besides the fuel, it generally contains control apparatus, moderator, coolant, etc., and is often surrounded by a biological shield. A nuclear fusion reactor is a structure in which a fusion reaction in a nuclear fuel capable of fusing is controlled or manipulated. Although it is implied that the rate of such reactions increases as the relative velocities of such particles at the time of collision, nothing is implied about the means by which such precollision velocities are attained. The same reaction may and usually does produce one or more other particles such as neutrons or protons, in accordance with well-known reactions.

PINCH EFFECT

The self-constriction that occurs in a plasma as a result of the passage of a unidirectional current, which current produces an azimuthal self-magnetic field that tends to constrict (or pinch) the plasma; or the equivalent effect which is produced when a plasma is contained between parallel circuits carrying current in the same direction attracting each other.

PLASMA

For the purpose of this class is a very hot, at least partially, ionized gaseous system consisting of equivalent (substantially so) numbers of positive ions and electrons, irrespective of whether neutral particles are present or not. It is nearly neutral electrically and highly conducting. See also Fully Ionized and subclasses 100+.

REACTION BY-PRODUCTS

See By-Product Materials.

REACTIVITY

A measure of the amount of the possible departure of a reactor from the critical condition where the reaction is just self-supporting. At any steady state of operation the reactivity is zero. Addition of positive reactivity causes divergence; addition of negative reactivity causes the reaction to die down.

REACTIVITY AFFECTING MATERIAL

As it relates to fission nuclear reactors, this is a material which affects the criticality of the reactor and can be (a) a neutron absorbing material (which for the purpose of this class is a material which can absorb neutrons without reproducing them, e.g., boron, or a fertile material such as uranium (U^{238} or thorium) thus providing a decrease in reactivity, (b) a fissionable material such as U^{235} , Pu^{239} , U^{233} (thus providing an increase in reactivity), and (c) a reflector (moderator) material such as graphite or water (thus providing an increase in reactivity).

REACTOR CORE (FISSION REACTOR)

The central or heart of a nuclear reactor containing as its main constituent the nuclear fuel (e.g., enriched uranium, Pu^{239} , etc.), and the moderator, if any. Also known as the active volume of the reactor.

REACTOR GEOMETRY (FISSION REACTOR)

See subclasses 347+.

REFLECTOR

A volume of material placed around the active volume (core) or other neutron yielding source serving to scatter back into the active volume some of the neutrons which would otherwise be lost to the chain reaction thus permitting a reduction in the critical size of the active volume.

SAFETY ELEMENT OR ROD

See Control Element.

SCRAM ROD

See Control Element.

SHIELD

For the purpose of this class, generally a mass or armor of concrete, lead or other heavy material or other neutron absorbing material erected around a reactor or other radioactive source to shield operating staff by absorbing and reducing dangerous radiations (especially neutrons and gamma rays) to permissible levels. See also Neutron Absorbing Material.

SHIM

See Control Element.

SLURRY

See Homogeneous Reactor.

SPALLATION

A nuclear reaction induced by high energy bombardment and involving the ejection of two or more small particles or fragments leaving only one large residual nucleus.

SPECIAL NUCLEAR MATERIAL

See Nuclear Fuel (b).

SPLITTING

See Fission.

STRIPPED OF ORBITAL ELECTRONS

See Fully Ionized.

SUBATOMIC PARTICLES

All particles of less than atomic mass, i.e., the elementary particles (proton, neutron, electron, positron, neutrino, meson, etc.) as well as the alpha particles and deuterons, the charge and mass of which indicates them to be composite particles.

SUBCRITICAL (FISSION) REACTOR

For the purpose of this class, is a reactor which has (a) an active volume (core) containing less than the necessary amount of fissionable material (fuel) to become critical, and (b) an auxiliary neutron source combined therewith in such a way as to trigger fissioning with the active volume and with proper amplification of neutrons whereby a steady state chain reaction results, i.e., it becomes critical.

TARGET

The substance which is subjected bombardment by particles of photons of high energy in order to produce nuclear reactions therein.

THERMAL NEUTRONS

As the energy of any substance has a temperature factor, that of the prevailing temperature is termed thermal energy, and when neutrons reach equilibrium with the moderator they are called thermal neutrons. Their most probable energy is about 0.025 ev; or the speed of a gas molecule at room temperature. It is this type of neutron that can best enter the nucleus of a fissionable atom and remain there long enough to excite the atom to the breaking point, attaining fission. Two other categories of neutrons are intermediate and fast. Fast neutrons are those resulting from fission that have lost relatively little of their energy by collision, etc.; having energies exceeding 0.1 Mev. Intermediate neutrons have energies lying between thermal and fast neutrons.

THERMONUCLEAR FUEL

See Nuclear Fuel.

THERMONUCLEAR (FUSION) REACTORS

Apparatus in which fusion reactions occur primarily as the result of random collisions within the apparatus between gas particles having a Maxwellian distribution

of velocities about some average temperature. It is implied that such reactions are not the result of accelerating one particle into another. While it is also implied that a high average gas temperature is sought for to attain a high thermonuclear reaction rate, nothing is implied as to the attainment of any minimum temperature.

TRANSMUTATION

The bombardment of a nucleus by particle or photon so as to bring about a change in the nucleus resulting in a different isotope of the original nucleus or resulting in different element(s).

SUBCLASSES

100 NUCLEAR FUSION:

This subclass is indented under the class definition. Subject matter comprising structures and processes in which two reacting nuclei are combined to yield at least one nucleus having a greater mass than either of the reacting nuclei.

- (1) Note. Subject matter of this subclass and of the subclasses indented hereunder may include, for example, reactions and methods including neutron generators wherein the neutron is a product of a fusion reaction, e.g., A D-T reaction.
- (2) Note. Patents are included in this and indented subclasses even if there is failure of the system to actually obtain fusion if it is clear that the intent or aim of the patent is to obtain it.
- (3) Note. Neutrons from an ionized or plasma system or reaction may be appropriately utilized or moderated to bring about or cause a fission-type nuclear reaction.
- (4) Note. Energy or heat of a nuclear fission reaction system may be appropriately utilized to bring about ionization to plasma or fusion reaction levels.

SEE OR SEARCH CLASS:

219, Electric Heating, subclasses 121.36+ for plasma heating.

101 Pellet guidance system (e.g., pellet injection means):

This subclass is indented under subclass 100. Subject matter wherein a fusion fuel body is caused to be directed to a predetermined position.

SEE OR SEARCH CLASS:

- 250, Radiant Energy, subclasses 396+ for deflection or focusing of charged particles.
- 315, Electric Lamp and Discharge Devices: Systems, subclass 507 for injection or extraction of charged particles.

102 Inertial confinement (e.g., nuclear explosive):

This subclass is indented under subclass 100. Subject matter wherein the reacting nuclei are contained in a fuel body and the disassembly of the body is prevented or retarded for a predetermined time by mass forces within the body, said nuclei being caused to react by the application of external or internal sources of energy.

- (1) Note. The above mass forces includes but is not restricted to the mass of outer layer.
- (2) Note. Nuclear explosives are included in this and indented subclasses. The nuclear explosive may include a chemical explosive to aid in causing the nuclei to react.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 151+, for fuel bodies of this subclass type, per se.

103 Photon beam (e.g., laser) irradiation:

This subclass is indented under subclass 102. Subject matter wherein the source of energy is a source of coherent electromagnetic radiation.

SEE OR SEARCH CLASS:

- 219, Electric Heating, subclasses 121.6+ for laser heating of a material in general.
- 372, Coherent Light Generators, appropriate subclasses for laser structure.

104 Optics:

This subclass is indented under subclass 103. Subject matter wherein a laser beam is directed to the fuel body by way of reflectors and/or refractors.

105 Particle beam irradiation (excluding photons):

This subclass is indented under subclass 102. Subject matter wherein the source of energy is either a charged particle beam or a neutral particle beam.

SEE OR SEARCH CLASS:

- 219, Electric Heating, subclasses 121.12+ for electron beam heating of a material in general.
- 250, Radiant Energy, subclass 492.3 for electron beam irradiation of a material in general.

106 Ion beam irradiation:

This subclass is indented under subclass 105. Subject matter wherein the charged particles are ions.

SEE OR SEARCH CLASS:

- 250, Radiant Energy, subclass 492.3 for ion irradiation of a material in general.

107 Fusion reaction by plural colliding plasmas or particle beams:

This subclass is indented under subclass 100. Subject matter wherein the nuclei which are to undergo reaction are in the form of plasma or beams which are directed towards and caused to impact one another so as to cause the fusion reaction.

108 Including accelerating particles into a stationary or static target (e.g., cockcroft-walton generator type):

This subclass is indented under subclass 100. Subject matter wherein at least one of the reacting nuclei is directed into a fixed fuel body containing the other of the reacting nuclei in nongaseous form with sufficient energy to produce fusion.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:
 107, for patents which may also illustrate structure for accelerating charged particles.
 151+, for fuel bodies of this subclass type, per se.
- 109 With target replenishing:**
 This subclass is indented under subclass 108. Subject matter having structure or steps for renewing or replacing the nuclei in the fixed fuel body.
- 110 With means for modifying the resultant neutron output, e.g., moderator means:**
 This subclass is indented under subclass 108. Subject matter wherein the reacting nuclei produce a neutron of a given energy and wherein this given energy is altered or attenuated.
- 111 With means to pulsate ion beam:**
 This subclass is indented under subclass 108. Subject matter wherein a plurality of ionized nuclei are directed towards a target along a given path and the average number of nuclei in the path per unit volume varies with time.
- 112 Cyclotron type acceleration of nuclei:**
 This subclass is indented under subclass 108. Subject matter wherein the directed nuclei reach the sufficient energy through traversal of an orbital path.
- 113 With electrostatic voltage generating means:**
 This subclass is indented under subclass 108. Subject matter wherein the directed nuclei reaches the sufficient energy by means which creates a static electric accelerating potential.
 (1) Note. The accelerating potential can be provided by a Van de Grof belt-driven generator.
- 114 Self-contained neutron sources (e.g., neutron or accelerator tube):**
 This subclass is indented under subclass 108. Subject matter wherein all reacting nuclei are contained within the same enclosure and the product of the reacting nuclei includes a neutron.
- 115 With cooled electrodes or target:**
 This subclass is indented under subclass 114. Subject matter wherein either (a) the fixed fuel body, or (b) a conductor of electrical energy for accelerating or directing the nuclei has a provision for removal of heat therefrom.
 SEE OR SEARCH THIS CLASS, SUB-CLASS:
 151, for structured targets, per se, which may have provision for cooling incorporated therein.
- 116 With ion beam collimator or filtering structure (e.g., extractor electrode):**
 This subclass is indented under subclass 114. Subject matter wherein (a) the cross-sectional area, or (b) the density of the directed nuclei in space, traversed by the directed nuclei is altered prior to reaction with the fixed nuclei.
 (1) Note. The subject matter of this subclass provides for an extractor electrode or other means to modify the diameter of the ion beam.
- 117 With ion beam collimator or filtering structure:**
 This subclass is indented under subclass 108. Subject matter wherein (a) the cross-sectional area occupied by the directed nuclei, or (b) the density of the directed nuclei in space is altered prior to reaction with the fixed nuclei.
 (1) Note. The subject matter of this subclass provides for an extractor electrode or other means to modify the diameter of the ion beam.
- 118 Subterranean source:**
 This subclass is indented under subclass 108. Subject matter wherein the reaction between the reacting nuclei takes place beneath the surface of the earth.
- 119 With control circuitry:**
 This subclass is indented under subclass 108. Subject matter having electronic means to vary or regulate a parameter of the fusion apparatus.

120 Including bunched particle beam:

This subclass is indented under subclass 100. Subject matter wherein traveling in an ordered path organized in clusters at least some of the nuclei involved in the reaction traverse fixed paths in groups.

121 Magnetic confinement of plasma:

This subclass is indented under subclass 100. Subject matter wherein (a) the nuclei are in a plasma* state in a given volume, and (b) the plasma is restrained to the given volume through magnetic forces.

- (1) Note. Patents wherein magnetic forces solely generated by (a) electric discharge, or (b) self-generation in a plasma are not proper for this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 107, for patents which may also illustrate structure for magnetically accelerating ions or plasmas.

SEE OR SEARCH CLASS:

- 313, Electric Lamp and Discharge Devices, subclasses 231.01+ for plasma-type discharge systems.
315, Electric Lamp and Discharge Devices: Systems, subclasses 111.01+ for plasma-type discharge systems.

122 Plasma formed in situ by laser:

This subclass is indented under subclass 121. Subject matter wherein the nuclei after introduction into the given volume in a nonplasma state are changed to the plasma state with the aid of coherent light.

- (1) Note. The nuclei can be introduced into the given volume in the form of a liquid, solid, or gas.

123 Principal heating by wave energy:

This subclass is indented under subclass 121. Subject matter wherein most of the energy imparted to the nuclei for bringing the nuclei to a condition sufficient for reaction to take place is imparted through electromagnetic energy.

124 Heating by time varying magnetic field (e.g., by compression):

This subclass is indented under subclass 123. Subject matter wherein the electromagnetic energy is in the form of magnetic flux lines whose density changes with time so as to compress the confined plasma.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 132, for subject matter of this subclass type wherein the heating represents auxiliary heating.

125 Imploding liners:

This subclass is indented under subclass 121. Subject matter wherein the restraining of the nuclei is assisted by the sudden inward movement of a body which at least partially encloses the plasma.

- (1) Note. Liners of this subclass type may be either liquid or solid.

126 With enveloping charged particle confinement (e.g., with e or p layer):

This subclass is indented under subclass 121. Subject matter wherein the magnetic force cooperates with a charged particle layer (e.g., a layer of electrons or protons) separate from an external to the plasma to form a further restraining means for maintaining the plasma within the given volume.

- (1) Note. The enveloping charged particle layer can be formed from a beam of high energy particles injected within a cylindrical zone or chamber, which beam is parallel to and enveloping a long axis and is subjected to the effects of a magnetic field in a way so as to contain a plasma between it and the long axis of the chamber.
(2) Note. The rotary motion of an E layer would generally be in a direction opposite to that of the contained plasma.

127 With injection of electrically charged or accelerated particles:

This subclass is indented under subclass 121. Subject matter wherein electrically charged or accelerated particulate bodies are injected into the given volume.

SEE OR SEARCH THIS CLASS, SUBCLASS:

107, for patents which may also illustrate structure for accelerating charged particles.

SEE OR SEARCH CLASS:

250, Radiant Energy, subclass 251 for acceleration of particles.

313, Electric Lamp and Discharge Devices, subclasses 359.1+ for acceleration of particles.

128 Plasma injection:

This subclass is indented under subclass 127. Subject matter wherein the particulate bodies comprise substantially equal numbers of positively and negatively charged ions.

(1) Note. The bodies may be in the form of protons and electrons.

129 Negatively charged particle injection:

This subclass is indented under subclass 127. Subject matter wherein the charged particulate bodies are comprised of electrons or ions of negative charge.

(1) Note. The particulate bodies of this subclass may be macroparticles, i.e., comprised of atoms and/or molecules, having an overall negative charge.

130 Neutral particle injection:

This subclass is indented under subclass 127. Subject matter wherein the particulate bodies have no net charge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

128, for subject matter wherein the particulate bodies comprise substantially equal numbers of positively and negatively charged ions.

131 Auxiliary heating:

This subclass is indented under subclass 121. Subject matter wherein supplemental energy is introduced into the given volume.

132 Electromagnetic wave energy:

This subclass is indented under subclass 131. Subject matter wherein the energy is selected from a predetermined portion of the electromagnetic spectrum.

133 Toroidal confinement of plasma:

This subclass is indented under subclass 121. Subject matter wherein the given volume is generated by a rotation of a plane closed curve about an axis lying in its plane.

(1) Note. The given volume may be in the shape of a torus, or doughnut or race track.

134 Divertors:

This subclass is indented under subclass 133. Subject matter for removing particles at the extremities of the given volume which would otherwise (a) impact on means (i.e., chamber) physically containing the volume, or (b) enter the given volume and mix with the plasma.

(1) Note. The difference between the divertors of this subclass type and the limiters and liners of subclass 136 is that the divertors remove the particles, as by means of gaseous flow or magnetic fields, whereas limiters and liners are structural elements which trap or absorb the particles.

135 Effuser:

This subclass is indented under subclass 134. Subject matter wherein the removal is accomplished by means of a gaseous stream.

(1) Note. The gas stream is usually flowing tangentially to the enclosure.

136 Limiters or liners:

This subclass is indented under subclass 133. Subject matter for protecting at least a portion of physical means (i.e., chamber) containing the given volume.

- 137 With solid internal conductor:**
This subclass is indented under subclass 133. Subject matter wherein at least a portion of the magnetic restraining force is created by electrical current-carrying structure located within means (i.e., chamber) physically containing the volume.
- 138 Bumpy torus:**
This subclass is indented under subclass 133. Subject matter having means (i.e., chamber) physically containing the given volume and wherein the physical surface of the means has regularly spaced depressions.
- 139 Linear confinement:**
This subclass is indented under subclass 121. Subject matter wherein the given volume forms a linear containment zone or chamber for the plasma, the lines of magnetic force generally being concentric to the axis of the zone or chamber.
- 140 Mirror devices:**
This subclass is indented under subclass 139. Subject matter having substantially constant magnetic force along a portion of the axis of the zone or chamber with at least one other portion of the axis having a magnetic force whose intensity is substantially greater than the intensity of the constant magnetic force.
- 141 Plasma formed or contained between spaced electrodes:**
This subclass is indented under subclass 140. Subject matter wherein the plasma is bounded on two sides by electric charge-carrying conductors.
- 142 Magnetic structure:**
This subclass is indented under subclass 121. Subject matter comprising means for producing magnetic confinement forces and support structure therefore.
- (1) Note. This may include the coil design by itself or other additional features of the electromagnet system such as a coil support structure, a coil cooling system.
- 143 With circuitry:**
This subclass is indented under subclass 121. Subject matter wherein electrical signal processing means is employed to vary, determine, or otherwise affect the physical characteristics of the reacting nuclei in a fusion device directly or indirectly.
- 144 Plasma formed between spaced electrodes:**
This subclass is indented under subclass 100. Subject matter wherein the plasma is produced by an electrical discharge between two current carrying conductors.
- 145 Plasma focus:**
This subclass is indented under subclass 144. Subject matter wherein compression of the plasma is induced by magnetic forces generated by the electrical discharge and/or by magnetic forces self-generated in the plasma.
- 146 Including removal or use of impurities or reaction products (e.g., energy):**
This subclass is indented under subclass 100. Subject matter for removing (a) reaction products which may be in the form of particles (charged or neutral) or electromagnetic radiation, or (b) undesired particles which have been introduced into the given volume, or (c) a portion of the energy of the particles.
- SEE OR SEARCH CLASS:
60, Power Plants, subclass 203.1 for propulsion systems involving radiant energy.
- 147 Direct conversion of energy:**
This subclass is indented under subclass 146. Subject matter wherein a portion of the energy of the particles is transformed into electrical output with the use of a one-step process or apparatus for accomplishing said one-step process.
- (1) Note. Subject matter of this subclass type includes, for example, MHD conversion.
- 148 Including use of heat or radiation to effect a chemical reaction:**
This subclass is indented under subclass 146. Subject matter wherein the electromagnetic or thermal energy resulting directly or indirectly

from the reaction of the nuclei causes or aids a chemical reaction between materials other than said nuclei.

149 Shock wave heating of plasma or gas (e.g., mhd heating):

This subclass is indented under subclass 100. Subject matter wherein the nuclei which are to undergo reaction are in a plasma or gaseous state and wherein the plasma or gas is subjected to compressional force acting at a rate greater than the velocity of a compressional wave through the plasma or gas.

- (1) Note. The action of force on the plasma or gas may be direct or indirect.
- (2) Note. The shock wave may be produced by an electrical discharge.

150 Chamber structure or material:

This subclass is indented under subclass 100. Subject matter including details of the geometry or composition means (i.e., chamber) for physically containing a given volume in which the nuclear fusion reaction occurs.

- (1) Note. Subject matter under subclass type must consist of more than a nominal recitation of a toroidal chambers. A geometrical description of the type in subclass 133 of a normal toroid is considered a nominal recitation of a toroidal chamber for purposes of this subclass.

151 Fusion targets or pellets:

This subclass is indented under subclass 100. Subject matter wherein either (a) the two nuclei are caused to react with the aid of an irradiating energy beam, or (b) one of the two nuclei is part of an energy beam which is to irradiate the other nuclei to cause the two nuclei to combine, and (c) wherein at least one of the irradiated nuclei comprises in part a fusion fuel body having physical characteristics determined by the nature of the irradiating energy beam.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 109, for combination of target, accelerator, and provision for replenishing the target.
- 115, for combination of target, accelerator, and provision for cooling the target.

SEE OR SEARCH CLASS:

- 427, Coating Processes, appropriate subclasses for methods of making the targets.
- 445, Electric Lamp or Space Discharge Component or Device Manufacturing, subclasses 1+ for methods of making targets.

152 For inertial confinement:

This subclass is indented under subclass 151. Subject matter wherein the physical characteristics of the fuel body are such that the disassembly of the body is prevented or retarded for a predetermined time by mass forces within the body when the body is irradiated by an energy beam of coherent light.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 103, for laser irradiation of targets or pellets of this subclass (152) type.

153 DETECTION OF RADIATION BY INDUCED NUCLEAR REACTION:

This subclass is indented under the class definition. Subject matter wherein the induced nuclear reaction takes place in response to the incidence of electromagnetic or particulate energy upon the material and a product of the nuclear reaction within a structure, which structure is used to indicate incidence of such radiation.

- (1) Note. Class 376, this subclass takes all detection whose claims include an induced nuclear reaction.
- (2) Note. The reactions may include $B^{10} + N \rightarrow Li^7 + He^4$, $He^3 + N \rightarrow H^3 + p$ (proton recoil), $B^{11} + N \rightarrow (B^{12}) C^{12} + e$, or $N^1 + Li^6 \rightarrow H^3 + He^4$.

SEE OR SEARCH CLASS:

- 250, Radiant Energy, subclasses 390.01+ for neutron responsive means which claim no induced nuclear reaction.

154 By fission:

This subclass is indented under subclass 153. Subject matter wherein the reaction is fission, i.e., the splitting of a nucleus.

- 155 With boron:**
This subclass is indented under subclass 153. Subject matter wherein the nucleus undergoing nuclear reaction is boron.
- 156 NUCLEAR TRANSMUTATION (E.G., BY MEANS OF PARTICLE OR WAVE ENERGY):**
This subclass is indented under the class definition. Subject matter comprising the bombardment of a material to produce an induced nuclear reaction other than that resulting in the splitting of a nucleus.
- (1) Note. The subject matter of this class includes reactions wherein a nucleus of the material is converted or transformed into a different nucleus; inclusive of (a) making the material radioactive, (b) producing isotopes of the same or a different element, e.g., Co^{59} Co^{60} , Th^{232} U^{233} , and (b) producing annihilation radiation, e.g., a matter antimatter reaction.
- (2) Note. Where a substance such as U^{238} (or other material) is merely used as a fuel carrier with no stated intention of converting it to fuel, the substance U^{238} is not regarded as fertile material for this and indented subclasses.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
340, for reactors, per se, specifically designed to provide for the irradiation of material to produce a nonfission reaction.
- SEE OR SEARCH CLASS:
117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, and such processes combined with perfecting operations. A subsequent step of irradiation to produce a nuclear transformation is provided for in Class 376.
- 424, Drug, Bio-Affecting and Body Treating Compositions, subclasses 1.11+ for class defined compositions and methods comprising a radionuclide or intended radionuclide.
- 157 Gamma or charged particle activation analysis:**
This subclass is indented under subclass 156. Subject matter wherein gamma or charged particle bombardment of the material results in the production of a transmuted nuclei of the material, which product is to be analyzed to yield data concerning the nucleus of the material and/or its environment.
- 158 By neutron bombardment:**
This subclass is indented under subclass 156. Subject matter wherein the material is bombarded with neutrons.
- SEE OR SEARCH CLASS:
250, Radiant Energy, subclasses 390.01+ for neutron responsive means involving no induced nuclear reaction.
423, Chemistry of Inorganic Compounds, subclasses 2+ and 249+ for radioactive materials and treatment thereof which does not involve irradiation to produce the radioactive material.
- 159 Neutron activation analysis:**
This subclass is indented under subclass 158. Subject matter wherein the neutron bombardment of the material results in the production of a product which is to be analyzed to yield data concerning the nucleus of the material and/or its environment.
- 160 Subterranean:**
This subclass is indented under subclass 159. Subject matter wherein the bombardment takes place beneath the surface of the earth.
- (1) Note. As between Class 376 and Class 250, subclasses 253-269.8 (well-logging), Class 376 takes all well-logging apparatus and processes involving induced nuclear reactions even if only nominally recited except when the nuclear reaction is nominally recited and the signal processing steps or apparatus are recited in detail (e.g., developing of a

ratio of two signals, classification is in Class 250, subclasses 253-269.8.

161 Specific nuclides:

This subclass is indented under subclass 160. Subject matter wherein a specified activated nucleus is recited.

162 Metals:

This subclass is indented under subclass 161. Subject matter wherein the recited nucleus is a nucleus of a metal atom.

163 Aluminum, silicon:

This subclass is indented under subclass 162. Subject matter wherein the metal nucleus is either aluminum or silicon.

164 Uranium:

This subclass is indented under subclass 162. Subject matter wherein the metal nucleus is uranium.

165 Hydrogen, chlorine:

This subclass is indented under subclass 161. Subject matter wherein the recited nucleus is either hydrogen or chlorine.

166 Oxygen, carbon:

This subclass is indented under subclass 161. Subject matter wherein the recited nucleus is either oxygen or carbon.

167 With tracer injection:

This subclass is indented under subclass 160. Subject matter wherein the material is injected into the earth and then activated or transmuted.

(1) Note. The material is usually in fluid form.

168 Halogens:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded by neutrons is a halogen.

169 Iodine:

This subclass is indented under subclass 168. Subject matter wherein the halogen is iodine.

170 Actinides:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded by neutrons is an element of atomic number 89 or greater.

171 Breeder or converter reactor structures:

This subclass is indented under subclass 170. Subject matter wherein the material bombarded with neutrons is a fertile material and this fertile material is a component of and positioned in, a nuclear fission reactor* comprised of two or more of the following structural elements: moderator structure, fuel structure, coolant structure (including primary coolant, per se), or fuel support structure.

(1) Note. The nuclear reactor will generally comprise a core of fissile fuel assemblies with or without moderator, and a coolant. The fertile material may be (1) positioned in the fissile fuel assembly either (a) mixed with the fissile fuel material itself, or (b) as a separate distinct component of the fissile fuel assembly; or (2) positioned in a nonfissile fuel assembly, i.e., a fertile fuel assembly.

(2) Note. Methods of operation directed refueling schemes are provided for in subclass 267.

172 Fertile fuel assembly structure or arrangement:

This subclass is indented under subclass 171. Subject matter wherein the structure or arrangement of the fertile material component is more than nominally recited.

173 Having internal fertile regions:

This subclass is indented under subclass 172. Subject matter wherein components containing fertile material are positioned inside the reactor core proper.

(1) Note. Since it is normal for most fissile fuel components to include fertile materials along with the fissile materials and still be classified as fissile fuel components, for a patent to be placed in this subclass as an original, there must be such a preponderance of fertile material

present that the component itself is classified as a fertile fuel component.

174 Having particular coolant fluid flow path or pattern within reactor core:

This subclass is indented under subclass 171. Subject matter wherein the coolant* is made to traverse a specifically defined route or channel within the reactor core or the route taken is such as to place the coolant into a pattern or network.

- (1) Note. The recitation of a coolant flowing or circulating through the reactor core is not by itself proper subject matter for this subclass.

175 Orifice or fluid control at inlet or outlet of coolant channels:

This subclass is indented under subclass 174. Subject matter wherein means are provided which will alter the amount of coolant which is (a) flowing into the coolant channel, or (b) flowing out of the coolant channel.

SEE OR SEARCH THIS CLASS, SUBCLASS:
352, for similar subject matter.

176 Hydraulic holddown:

This subclass is indented under subclass 175. Subject matter wherein a fuel assembly is positioned in the coolant channel and the pressure of the coolant is utilized to help maintain the fuel assembly in its desired position in the coolant channel.

177 Plural coolant loops or passes through reactor core:

This subclass is indented under subclass 174. Subject matter wherein (a) coolant is caused to traverse the reactor core through separate and independent routes, or (b) coolant is caused to traverse the reactor core a plurality of times prior to its being sent to a heat exchanger or other utilization means which would remove the heat from the coolant.

178 Fuel assembly holddown or support:

This subclass is indented under subclass 171. Subject matter wherein means are provided for maintaining the fuel assembly in its desired position within the nuclear reactor.

179 Coolant manipulated and used exterior of reactor core:

This subclass is indented under subclass 171. Subject matter wherein the coolant circulating within the reactor core area has energy (e.g., thermal or kinetic) added to or removed therefrom (e.g., by a heat exchanger, pump, or turbine) exterior of the reactor core.

- (1) Note. The "energy" may be transferred by heat exchange to a secondary fluid, etc., which is then utilized in a turbine.

180 Formation of uranium isotopes:

This subclass is indented under subclass 170. Subject matter wherein the neutron bombardment of the actinide material results in the production of uranium isotopes.

181 Uranium 233:

This subclass is indented under subclass 180. Subject matter wherein the isotope produced is U-233.

182 Formation of plutonium isotopes:

This subclass is indented under subclass 170. Subject matter wherein the neutron bombardment of the actinide material results in the production of plutonium isotopes.

183 Doping of semiconductors:

This subclass is indented under subclass 158. Subject matter wherein the material is a semiconductor which contains an element which is converted to a desired dopant by the neutron bombardment.

SEE OR SEARCH CLASS:

117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, and such processes combined with perfecting operations. A process comprising the step of irradiation to produce a nuclear transformation is provided for in Class 376.

438, Semiconductor Device Manufacturing: Process, subclass 512 for methods of introducing an electrically active dopant into a semiconductor

region having a combination of diverse steps in which one step involves the conversion of an element into a dopant by nuclear transmutation.

184 Rare earths:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded is at least one of La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.

185 Alkali and alkaline elements:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded is selected from Group I or Group II of the periodic table.

186 Molybdenum, technetium:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded is molybdenum or technetium.

187 Lead, polonium, bismuth:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded is lead, polonium, or bismuth.

188 Sulfur, phosphorus:

This subclass is indented under subclass 158. Subject matter wherein the material bombarded is sulfur or phosphorus.

189 With reaction product treatment (e.g., recovery, separation):

This subclass is indented under subclass 158. Subject matter wherein the neutron bombarded material or its by-products are treated or acted on.

190 By charged particle bombardment:

This subclass is indented under subclass 156. Subject matter wherein the bombardment of the material is effected with electrically charged particles.

191 Alpha-neutron sources:

This subclass is indented under subclass 190. Subject matter wherein the charged particles is an alpha particle and a by-product of the reaction is a neutron.

192 To produce spallation reaction:

This subclass is indented under subclass 190. Subject matter wherein the charged particle bombardment causes the ejection of two or more particles from a nucleus in the material.

- (1) Note. The ejected particles can be neutrons, protons, deuterons, alpha particles, etc.

193 To produce fissile isotopes:

This subclass is indented under subclass 192. Subject matter wherein the ejected particles produce fissile isotopes in a second material.

194 Proton bombardment:

This subclass is indented under subclass 190. Subject matter wherein the charged particle is a proton.

195 With reaction product treatment (e.g., recovery, separation):

This subclass is indented under subclass 194. Subject matter wherein the proton bombarded material or its by-products are treated or acted on.

196 Alpha (helium nucleus) bombardment:

This subclass is indented under subclass 190. Subject matter wherein the charge particle is an alpha particle.

SEE OR SEARCH THIS CLASS, SUBCLASS:

191, for alpha-neutron sources.

197 Wherein the reaction product is an actinide or transuranium element:

This subclass is indented under subclass 196. Subject matter wherein the alpha bombardment of the material produces an element of atomic number 89 or greater.

SEE OR SEARCH THIS CLASS, SUBCLASS:

192, wherein alpha particles cause spallation.

- 198 With reaction product treatment (e.g., recovery, separation):**
This subclass is indented under subclass 196. Subject matter wherein the alpha bombarded material or its by-products are treated or acted on.
- 199 Deuteron bombardment:**
This subclass is indented under subclass 190. Subject matter wherein the charged particle is a deuteron.
- 200 Wherein the reaction product is an actinide or transuranium element:**
This subclass is indented under subclass 199. Subject matter wherein the deuteron bombardment of the material produces an element of atomic number 89 or greater.
- 201 With reaction product treatment (e.g., recovery, separation):**
This subclass is indented under subclass 199. Subject matter wherein the deuteron bombarded material or its by-products are treated or acted on.
- 202 Irradiation capsule, holder, or support:**
This subclass is indented under subclass 156. Subject matter wherein the material to be bombarded is in a carrier or other support structure and this carrier or other support structure is subsequently used to convey, position, or insert the material into or remove it from the vicinity of the radiation means.
- (1) Note. Subject matter of this subclass type includes, for example, insertable carriers of the rabbit tube type.
- 203 SEAL ARRANGEMENT:**
This subclass is indented under the class definition. Subject matter for substantially preventing the escape of fluid from a joint between two elements of a nuclear reactor fluid confining means.
- SEE OR SEARCH CLASS:
277, Seal for a Joint or Juncture, for a generic sealing means or process, subclasses 628+ for a static contact seal for other than an internal combustion engine, or a pipe, conduit, or cable.
- 204 For nozzle:**
This subclass is indented under subclass 203. Subject matter wherein one of the two elements is a fluid conduit which projects from a surface of a pressure vessel.
- 205 Between pressure vessel cover and vessel or portion thereof:**
This subclass is indented under subclass 203. Subject matter wherein one of the elements is a container, the interior pressure of which is different from the ambient pressure and the other element is a closure element for such a container.
- 206 Rotating plug-type cover:**
This subclass is indented under subclass 205. Subject matter wherein the closure means is capable of rotary movement.
- 207 WITH CONTROL OF REACTOR (E.G., CONTROL OF COOLANT FLOW):**
This subclass is indented under the class definition. Subject matter for changing (including “shut down”) or maintaining constant the fission reaction rate or power output of a nuclear fission reactor.
- (1) Note. Detection of a reactor state is proper subject matter for this subclass provided it is in combination with a control means for the fission reactor.
- (2) Note. For the structure of the subcombination control component which is an absorber, see this class (376), subclass 327.
- 208 Pulsed reactors:**
This subclass is indented under subclass 207. Subject matter involving a nuclear reactor which is designed to be operated in a pulsed mode or which is designed for the sudden injection of a large amount of reactivity.
- 209 Spectral shift:**
This subclass is indented under subclass 207. Subject matter wherein control is realized through an adjustment made to the energies of the total neutron population.
- (1) Note. For purposes of this subclass, the word “total” in regard to neutron popula-

tion means the overall or core-wide neutron population.

210 By coolant flow:

This subclass is indented under subclass 207. Subject matter wherein the control involves changing the rate at which a given mass of coolant enters or exits a fixed volume of reactor structure.

211 Exterior of core (e.g., secondary loop control):

This subclass is indented under subclass 210. Subject matter wherein the fixed volume is located outside of the primary coolant loop of the reactor.

212 By altering quantity or characteristic of fuel within critical area:

This subclass is indented under subclass 207. Subject matter wherein control of the fission reaction is realized (a) by reducing the effective quantity of fission fuel in the critical area, or (b) by effecting an in situ change in the physical state of the fuel.

- (1) Note. The change of the physical state is brought about by the lowering of density, such as by melting.

213 Wherein control element includes a fissile material:

This subclass is indented under subclass 212. Subject matter wherein a control element includes a material which increases the neutron population present.

214 Reactor start-up:

This subclass is indented under subclass 207. Subject matter wherein the fission rate is manipulated to achieve a critical condition having at least as many neutrons produced by fission as their are fissions, i.e., self-sustaining fission reaction.

215 By electronic signal processing circuitry (e.g., plural redundant circuits):

This subclass is indented under subclass 207. Subject matter comprising electronic circuit means which derives a control signal for raising or lowering reactor power from an electrical signal representative of a measured reactor variable.

SEE OR SEARCH CLASS:

340, Communications: Electrical, subclasses 500+ for condition responsive electrical systems in general.

216 Plural sensed different conditions or measured variables correlated:

This subclass is indented under subclass 215. Subject matter wherein representation of at least two different measured variables are utilized in the formulation of the control signal.

- (1) Note. The body of art in this subclass is that which utilizes, for example, electronic computers to analyze practically instantaneously, a number of reactor variables or conditions and to automatically warn of change of a critical reactor condition or actually apply the safety control or other element; to energize a system which automatically makes the appropriate adjustment.

SEE OR SEARCH CLASS:

235, Registers, appropriate subclasses for electronic computers or calculators, per se.
236, Automatic Temperature and Humidity Regulation, appropriate subclasses for the automatic temperatures and humidity regulation.

217 Control programs:

This subclass is indented under subclass 216. Subject matter wherein at least one of the measured variables is caused to be altered by a computerized program or its analog equivalent so as to produce a predetermined desired result.

218 Xenon control:

This subclass is indented under subclass 217. Subject matter wherein an operating program is developed to minimize the xenon concentration in the nuclear fuel.

219 By movement of control element or by release of neutron absorbing material:

This subclass is indented under subclass 207. Subject matter wherein control is realized by the insertion or withdrawal of a reactivity affecting material from the area occupied by fissioning reactor fuel.

- (1) Note. For the Structure of the subcombination of the control component, per se, see this class (376), subclass 327.
- 220 Wherein the control element is a reflector or moderator material:**
This subclass is indented under subclass 219. Subject matter wherein the control element is fabricated from a material which either attenuates incident neutron energy or alters the vector velocity of the neutron.
- 221 Variable fluent reflector/moderator level or density:**
This subclass is indented under subclass 220. Subject matter wherein a quantity of liquid, gaseous, or particulate material having the capacity to alter neutron energy or velocity relative to the quantity of fission fuel can be changed.
- 222 Moderator dump:**
This subclass is indented under subclass 221. Subject matter wherein the fluent material is rapidly or completely withdrawn.
- 223 Rotatable control elements:**
This subclass is indented under subclass 219. Subject matter wherein the surface of the control element adjacent the surface of a fuel element revolves about an axis parallel to each of said surfaces.
- 224 Finger-type control elements (insertable into fuel element positions):**
This subclass is indented under subclass 219. Subject matter wherein plural control elements joined at their points most remote from the fission fuel are moved into a repetitive assemblage of fission fuel elements to vacant positions which would otherwise be occupied by fission fuel elements.
- 225 Including shock absorber:**
This subclass is indented under subclass 224. Subject matter wherein the control elements are provided with some means to retard motion.
- 226 Wherein control element is driven directly into bed of fuel elements:**
This subclass is indented under subclass 219. Subject matter wherein the control element is moved into an assemblage of fuel elements having no fixed position.
- (1) Note. These fuel elements are usually piles of spherically shaped bodies.
- 227 Control element movable by means of cable and winch, chains or reels:**
This subclass is indented under subclass 219. Subject matter wherein the motion is induced by means of a flexible linear member.
- 228 Wherein driver or motivating is electric:**
This subclass is indented under subclass 219. Subject matter wherein the means to move the control element is electrically actuated.
- 229 Electrofluidic:**
This subclass is indented under subclass 228. Subject matter having motion induced by an electrical means which drives a fluid pressure means which in turn moves the control element.
- 230 Wherein driver or motivating is fluidic:**
This subclass is indented under subclass 219. Subject matter having motion directly produced by means of fluid pressure.
- 231 Pneumatic:**
This subclass is indented under subclass 230. Subject matter wherein the fluid is a gas.
- 232 By motion transforming means, e.g., rack and pinion:**
This subclass is indented under subclass 219. Subject matter wherein the movement of the control element is effectuated by at least a pair of interconnected and relatively movable motion transmitting members.
- 233 Releasable coupling:**
This subclass is indented under subclass 219. Subject matter wherein a disconnectable joint is provided between the control element and the means producing motion so that the motion means may be separated from the control element.

- 234 Including shock absorber:**
This subclass is indented under subclass 219. Subject matter wherein the control element is provided with a means to retard motion.
- (1) Note. The subject matter of this subclass type usually involves motion into the fuel elements.
- 235 Means for locking control element in desired position:**
This subclass is indented under subclass 219. Subject matter including means to prevent motion of the control element from a desired fixed position.
- 236 Including control rod insertion and removal schemes:**
This subclass is indented under subclass 219. Subject matter having specific patterns for the movement of control elements.
- (1) Note. This is usually done to improve the fuel consumption in region near the control elements.
- 237 Group movement of control elements:**
This subclass is indented under subclass 236. Subject matter wherein simultaneous movement is induced in a plurality of control elements.
- 238 Setback:**
This subclass is indented under subclass 236. Subject matter wherein the neutron control element is inserted into a fuel region to less than its full extent and maintained at that level for a predetermined time period.
- 239 Rod or support carrying plural elements or diverse materials:**
This subclass is indented under subclass 219. Subject matter wherein at least two neutron absorber elements, other nonfuel reactivity affecting mechanisms, or one of the above in combination with another reactor component are secured to each other and moved as a single unit.
- 240 Sensing or detecting device attached to, embedded in, or integral with control element:**
This subclass is indented under subclass 207. Subject matter wherein the structure of the control element includes a means for measuring the state of a reactor.
- (1) Note. The state is usually the temperature or neutron density.
- 241 Power output control (e.g., load follows with steam dump):**
This subclass is indented under subclass 207. Subject matter wherein control is realized through means external to the region of fission reaction which raises or lowers the deliverable energy of the system.
- (1) Note. For similar subject matter involving a boiling water reactor, see this class (376), subclass 379.
- 242 Means to inhibit control rod movement:**
This subclass is indented under subclass 207. Subject matter wherein a reactivity affecting material is locked in a fixed position relative to the reactor fuel for a predetermined time period.
- (1) Note. During this period normal control signals inducing movement are usually overridden.
- 243 With cooling of control element:**
This subclass is indented under subclass 207. Subject matter wherein provision is made to remove heat from the control element.
- 244 Temperature reactivity control:**
This subclass is indented under subclass 207. Subject matter wherein the fission rate of the fuel is changed by altering the temperature of the fuel.
- 245 TESTING, SENSING, MEASURING, OR DETECTING A FISSION REACTOR CONDITION:**
This subclass is indented under the class definition. Subject matter for determining the state of the reactor system or a component thereof.

- (1) Note. When the determination involves a nuclear reaction as a portion of the detection chain, see this class (376), subclass 153.
- (2) Note. Merely providing a window or a trap for visually detecting or sampling or inspecting or mentally judging is not considered as proper subject matter for this and indented subclasses.
- (3) Note. "Operation" or "reaction" is inclusive of the period from startup through shutdown.
- (4) Note. The "conditions" generally "measured" or "detected", etc., included such as for example, reactor power level, or reactor period, neutron density, neutron flux, neutron flux distribution, radioactivity or other radiations, temperature, etc.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 409, for fuel element having enclosed within it, or integrally associated with it, some means, device, or material which may be used to warn of a condition or in measuring, sensing, monitoring, etc., of a condition during normal use of the fuel.
- 450, for fuel element and its closure structure which includes a feature, means, or material useful or assisting in detecting or warning in regard to leaks or of an otherwise improperly constructed or functioning fuel element.
- SEE OR SEARCH CLASS:
- 73, Measuring and Testing, appropriate subclasses for testing or measuring of physical properties.
- 250, Radiant Energy, appropriate subclasses for miscellaneous measuring or detecting, etc., devices for use in conjunction with neutrons or other invisible radiations.
- 324, Electricity: Measuring and Testing, appropriate subclasses for testing or measuring of electrical properties.
- 340, Communications: Electrical, subclasses 500+ for condition responsive signalling.
- 374, Thermal Measuring and Testing, appropriate subclasses for measuring or testing of thermal properties.
- 246 Flowmeters:**
This subclass is indented under subclass 245. Subject matter wherein the state determined is the passage of a given fluid volume passing a fixed point per unit time.
- 247 Temperature or pressure measurement:**
This subclass is indented under subclass 245. Subject matter wherein the state being determined is a temperature or pressure of the reactor system or component thereof.
- SEE OR SEARCH CLASS:
- 374, Thermal Measuring and Testing, subclasses 100+ for temperature measurement, in general.
- 248 Optics:**
This subclass is indented under subclass 245. Subject matter wherein the state determined is the visual condition of a component.
- 249 Vessel monitoring or inspection:**
This subclass is indented under subclass 245. Subject matter wherein the state being determined is the integrity of a reactor vessel.
- SEE OR SEARCH CLASS:
- 901, Robots, subcollection 44 for robot devices which perform an inspecting operation.
- 250 Leak detection:**
This subclass is indented under subclass 245. Subject matter wherein the state being determined is the undesirable release of material from within a reactor system or component thereof.
- 251 Fuel element leak detection:**
This subclass is indented under subclass 250. Subject matter wherein the component is the fission fuel element.

- 252 By acoustic or ultrasonic wave energy:**
This subclass is indented under subclass 251. Subject matter wherein the determination is made by the analysis of compressional wave energy reflected or emitted from the fuel element.
- 253 By the detection of fission product external to the fuel element:**
This subclass is indented under subclass 251. Subject matter wherein the determination is made by sensing the presence of nuclear fission reaction product outside the fuel element.
- 254 Flux monitoring:**
This subclass is indented under subclass 245. Subject matter wherein the state being determined is the quantity of neutrons existing in a given area per unit time.
- 255 Directly generating electrical signal (e.g., ion detection):**
This subclass is indented under subclass 254. Subject matter wherein the determination is performed by electrical means directly responsive to neutrons which means produce an electrical signal proportional to neutron incidence.
- 256 Gas sensors (e.g., hydrogen detectors):**
This subclass is indented under subclass 245. Subject matter wherein the state determined is the presence of a particular gas in the reactor system or component, such as hydrogen.
- 257 Fuel assay (e.g., burnup):**
This subclass is indented under subclass 245. Subject matter wherein the state determined is the quantity of fissionable material, i.e., material whose nuclei have the capacity to split under irradiation, in a reactor fission fuel element.
- 258 Position detection:**
This subclass is indented under subclass 245. Subject matter wherein the state determined is the extent to which an element is inserted or withdrawn relative to the position of another element.
- 259 By particular instrumentation circuitry:**
This subclass is indented under subclass 245. Subject matter comprising electrical circuitry designed to process signals representing measured quantities from which the state can be determined.
- 260 HANDLING OF FISSION REACTOR COMPONENT STRUCTURE WITHIN REACTOR SYSTEM:**
This subclass is indented under the class definition. Subject matter for physically moving structure within the nuclear fission reactor system.
- (1) Note. "Handling" as used in this and indented subclasses includes moving, or any motion, of a component or segment thereof from one position or location to another within or to the outside of; or altogether externally of the reactor; and is inclusive also of a rotating or a reciprocating motion, but not of a stationary vibrating motion.
- (2) Note. The mere circulation of a fluid component is not considered as "handling" for this and indented subclasses; however, a peculiar or particular nature of circulation may be so considered.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
156, for particular "handling" of materials or components wherein nuclear conversion is also involved.
308, for "handling" of reactor materials not provided for elsewhere in this class. For example, the handling of fluid-type reaction products.
- SEE OR SEARCH CLASS:
414, Material or Article Handling, appropriate subclasses for handling devices and equipment, per se.
- 261 Fuel component:**
This subclass is indented under subclass 260. Subject matter wherein the object moved is the fission reactor fuel.
- (1) Note. The fuel material, component, or segment as used in this and indented subclasses may be a single fuel element or a cluster, etc., of fuel elements.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:
 308, for treatment of fission reactor material.
 356, for fuel dispersed in liquid moderator, etc.
 359, for fuel in molten state or in molten vehicle.
- 262 Including handling of a second different, diverse reactor component, (e.g., control element, moderator element, vessel cover removal):**
 This subclass is indented under subclass 261. Subject matter wherein the fission reactor fuel is moved together with another fission reactor system component.
- (1) Note. The fission reactor fuel may be moved relative to the other reactor component at the same time they are moved together relative to fixed element of the reactor system.
- 263 With pressure vessel cover removal:**
 This subclass is indented under subclass 262. Subject matter wherein the movement of fuel requires the prior movement of the closure of the fuel containing receptacle.
- 264 Charging or discharging of fuel:**
 This subclass is indented under subclass 261. Subject matter wherein the fuel is moved into or out of the nuclear fission reactor system.
- (1) Note. This normally referred to as refueling of the fission reactor.
- SEE OR SEARCH CLASS:
 74, Machine Element or Mechanism, appropriate subclasses for machine elements or mechanisms, per se, which can be used for mechanically manipulating the fuel or other reactor component.
 294, Handling: Hand and Hoist-Line Implements, subclasses 6+ for grapples for handling core components.
 414, Material or Article Handling, appropriate subclasses for material handling equipment, per se.
- 265 Refueling ball-type reactors:**
 This subclass is indented under subclass 264. Subject matter wherein the movement of fuel occurs within a nuclear fission reactor of the type wherein the fuel elements of which have a generally spherical shape.
- (1) Note. Such fission reactors are commonly referred to as pebble-bed reactors.
- 266 Means for separating low exposure from high exposure elements:**
 This subclass is indented under subclass 265. Subject matter wherein the movement of the fuel elements include means for directing fuel elements which have been in the reactor system for a short period of time to one location and means for directing fuel element which have been in the reactor system for a longer period of time to another location.
- (1) Note. Fuel elements which have no fuel left, i.e., are burned up, are usually removed from the reactor system.
- 267 Refueling schemes, patterns, or fuel cycles (e.g., in/out systems):**
 This subclass is indented under subclass 264. Subject matter wherein the movement involves at least a partial rearrangement of the fuel elements in the reactor system to new positions previously occupied by other fuel elements or by movement of the fuel from or to different portions of the reactor system.
- (1) Note. The purpose of the above is typically to improve fission fuel consumption.
- (2) Note. For the purpose of this subclass, the rearrangement of fuel elements may include the movement of other core elements such as control elements or reflector elements.
- 268 Refueling machines:**
 This subclass is indented under subclass 260. Subject matter wherein the object is an apparatus for moving fission fuel elements.

269 With magazine:

This subclass is indented under subclass 268. Subject matter wherein the transfer of fuel involves the use of a temporary fuel storage means.

- (1) Note. Subject matter of this subclass type includes for example, (a) fuel transferring machines which have the capacity to store a fuel element, and (b) transfer paths which have storage areas therein.

270 With nonaxial transfer capability:

This subclass is indented under subclass 268. Subject matter wherein the fuel element is rotated from a position in axial alignment with respect to its position in the core to another position about an axis which intersects the axis of its original alignment.

271 Upper axial transfer:

This subclass is indented under subclass 268. Subject matter wherein the fuel element is moved between its position in the core and a position above and in axial alignment with its core position by means located above the core.

272 Storage container systems for new and/or irradiated core elements:

This subclass is indented under subclass 260. Subject matter wherein reactor core elements are in a physical enclosure within the reactor system, which enclosure is distinct therefrom.

- (1) Note. Subject matter of this subclass type consists of more than a mere container for a single core element and therefore referred to as container systems. Structures consisting of more than one container, or storage for plural core assemblies, or one container with means to support or affix the container in a storage pool are typical of the systems of this subclass type, such systems are distinguished by their operative or structural association with nuclear reactors.
- (2) Note. Search Class 250, subclasses 506.1+, and 515.1+ for generic storage devices (particularly shipping casks for radioactive material).

- (3) Note. The storage systems herein may include a specific means for preventing (and therefor controlling) nuclear fission reactions, e.g., by the use of neutron absorber materials or by limiting the number of fuel elements in a given storage system.

- (4) Note. Included in this subclass are storage systems which include means for cooling the core elements.

- (5) Note. The storage systems herein are for core elements (new, used, or irradiated, or damaged) that still retain their structural form which identifies them as core elements, for example, before they have been physically or chemically altered for processing of the irradiated or radioactive material therein.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 347, for similar subject matter. The structure and also the cooling systems for the subject matter of this subclass (272) may be similar to the structure and cooling systems for the core elements in the nuclear reactor itself.

273 SUBTERRANEAN REACTOR STRUCTURES (E.G., UNDERGROUND CONFINEMENT, UNDERGROUND EXPLOSIVE):

This subclass is indented under the class definition. Subject matter wherein the reactor structure is recited as being located beneath the surface of the earth.

- (1) Note. Underground nuclear explosives are proper subject matter for this and indented subclass.
- (2) Note. The nuclear reaction energy may be obtained from nuclear explosives (either fission or fusion) or from a nuclear reactor.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 118, for subterranean systems utilizing Crockcroft-Walton Neutron generators.

- 160, for subterranean neutron activation analysis.
- 274 For minimizing radioactive contamination within an underground chamber or of the material removed therefrom:**
This subclass is indented under subclass 273. Subject matter wherein the reactor structure is in an underground cavity or is caused to form the cavity and radioactive contamination resulting from operation of the reactor structure is removed or reduced.
- 275 For extracting materials, or energy from the earth:**
This subclass is indented under subclass 273. Subject matter wherein the energy of the nuclear reaction is transferred to the earth or to the reactor structure surroundings so as to recover material or transferred energy therefrom.
- SEE OR SEARCH CLASS:
166, Wells, subclass 247 for similar processes which do not involve a nuclear reactor or which do not involve details of the nuclear explosive.
- 276 In the form of heated water or steam:**
This subclass is indented under subclass 275. Subject matter wherein the extracted energy or material is H₂O in a heated or vaporized state.
- 277 REACTOR PROTECTION OR DAMAGE PREVENTION:**
This subclass is indented under the class definition. Subject matter for reducing undesired effects resulting from the operation, malfunction, or failure of a nuclear fission reactor component.
- 1) Note. The utilization of shielding or insulation to reduce or prevent irradiation damage is proper subject matter for this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
274, for means or steps for minimizing radioactive contamination within an underground chamber or of the material removed therefrom.
- 278 By minimizing positive coolant void coefficient:**
This subclass is indented under subclass 277. Subject matter wherein means is provided which minimizes or reduces the amount of reactivity increase due to a loss of coolant.
- 279 Fire extinguishing or prevention:**
This subclass is indented under subclass 277. Subject matter wherein the burning of reactor components is the undesired effect.
- 280 Core catchers:**
This subclass is indented under subclass 277. Subject matter wherein component failure within the fissile and/or fertile region of a reactor is mitigated through the use of a barrier that slows or stops the egress of said component(s) from the region.
- (1) Note. The barrier will also serve to prevent the egress of any other component transported with the failed component.
- 281 Fluid flow reversal protection:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is a change in the direction of flow of a fluid within a reactor component.
- 282 Emergency core coolant systems (e.g., injecting coolant into reactor or pipe systems):**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is fuel melting which undesired effect is minimized by providing an alternate supply of coolant to the fuel in the event of stoppage or partial diminution of the normally present supply of coolant.
- (1) Note. The alternate coolant is usually supplied at a rate significantly lower than normal coolant.
- 283 Pressure suppression and relief:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is component damage (e.g., rupture) due to overpressure which undesired effect is minimized by providing an energy removal means to dissipate said overpressure.

- 284 By fusible means (e.g., ice):**
This subclass is indented under subclass 283. Subject matter wherein the energy removal means includes a material which absorbs energy through a physical change of state.
- 285 Expansion means (e.g., shock absorbers roller bearings):**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is the deformation of reactor components due to thermal stress which undesired effect is minimized by providing a structure to accommodate such deformation.
- 286 Pipe expansion joints:**
This subclass is indented under subclass 285. Subject matter wherein the structure is included in reactor piping system.
- 287 Shield or barrier between radiation or heat source and object to be protected (e.g., insulation, thermal shield):**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect (a) is the presence of radiation in a given area which undesired effect is minimized by providing means to attenuate the radiation prior to its entry into said area, or (b) to attenuate the egress of material into the area to be protected.
- (1) Note. Means to attenuate includes means to prevent or retard the egress of steam or effluent from a malfunctioning reactor component. Said steam or effluent will contain at least nominal radioactivity.
- 288 Particular materials:**
This subclass is indented under subclass 287. Subject matter wherein the means to attenuate includes a specific composition of matter.
- 289 Thermal insulation:**
This subclass is indented under subclass 287. Subject matter wherein the radiation attenuated is thermal radiation.
- 290 For liquid metal cooled fast reactors (e.g., insulation for vault roof, or for the vessel walls as by a layer of stagnant or quasi-stagnant coolant):**
This subclass is indented under subclass 289. Subject matter having the attenuation in a system which includes an unmoderated fission fuel system cooled by molten metal.
- 291 Concentric tubes or conduits with insulation:**
This subclass is indented under subclass 289. Subject matter wherein the means to attenuate thermal radiation is or supported by set(s) of nested cylinders.
- 292 Concentric tubes or conduits:**
This subclass is indented under subclass 287. Subject matter wherein the means to attenuate radiation and/or egress of material includes set of nested cylinders.
- (1) Note. The outer cylinder may provide an additional means to retard the egress of material within the inner cylinder.
- 293 Containment structures:**
This subclass is indented under subclass 287. Subject matter wherein the means to attenuate either (a) completely surrounds the fission fuel region, or (b) provides the last level of attenuation of radiation prior to its entry into the environment.
- 294 Pressure vessels:**
This subclass is indented under subclass 293. Subject matter wherein the means to attenuate completely surrounds the fission fuel region, and has the capacity to contain a pressurized fluid.
- 295 Concrete:**
This subclass is indented under subclass 294. Subject matter wherein the means to attenuate is constructed from a mixture of cement and aggregate.
- 296 Prestressed:**
This subclass is indented under subclass 295. Subject matter wherein the means to attenuate includes structure having built-in compressive or tensile forces.

- 297 With turbine protection means (e.g., turbine trip or overspeed protection means):**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is turbine damage which undesired effect is minimized by reducing or eliminating the energy transfer from the fissioning fuel.
- 298 Auxiliary heat removal structure:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is component overheating which undesired effect is minimized by providing additional thermal energy transfer from said component.
- SEE OR SEARCH CLASS:
165, Heat Exchange, appropriate subclasses for cooling towers.
261, Gas and Liquid Contact Apparatus, appropriate subclasses for cooling towers.
- 299 Decay heat removal:**
This subclass is indented under subclass 298. Subject matter wherein the components are the fission fuel bodies and the energy removed is generated when the reactor is shutdown.
- 300 Recombiners:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is the decomposition of water into hydrogen and oxygen which undesired effect is minimized by providing structures or processes to join the hydrogen and oxygen to form water.
- 301 Catalytic:**
This subclass is indented under subclass 300. Subject matter having a catalyst present to assist in the formation of water.
- 302 Core restraint means:**
This subclass is indented under subclass 277. Subject matter wherein the effect is the undesired movement of components in the region of the fission fuel bodies which effect is minimized by providing structures or processes to retard such movement.
- 303 In-core restraint means:**
This subclass is indented under subclass 302. Subject matter wherein the structures or processes to retard such movement are positioned among or within the fuel bodies.
- 304 For moderator structures:**
This subclass is indented under subclass 302. Subject matter wherein the components whose movement is retarded are those components which attenuate neutron energy.
- 305 Corrosion or damage prevention:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is the chemical decomposition of a reactor component which undesired effect is minimized (a) by providing the component with a barrier to retard the dissolution, or (b) by providing a reactant which will react with the corrosion causing agent to remove it from or reduce presence in the reactor system.
- 306 By addition of material to coolant:**
This subclass is indented under subclass 305. Subject matter wherein the barrier is established by the introduction of a material into the coolant which forms a barrier layer on the component or which will react with the corrosion causing agent.
- 307 With pressurizer means:**
This subclass is indented under subclass 277. Subject matter wherein the undesired effect is the uncontrolled or pressure variations which undesired effect is minimized by means for maintaining a desired coolant pressure.
- 308 FISSION REACTOR MATERIAL (INCLUDING REACTION PRODUCTS) TREATMENT:**
This subclass is indented under the class definition. Subject matter for adding or removing a material from the system or component thereof.
- 309 Post accident impurity or contaminant removal:**
This subclass is indented under subclass 308. Subject matter including the removal of material dislocated by accident or by the failure of a reactor component.

- 310 Impurity removal:**
This subclass is indented under subclass 308. Subject matter wherein undesired material is withdrawn from the system.
- 311 Reprocessing of fuel during reactor operation:**
This subclass is indented under subclass 310. Subject matter wherein impurities are removed from the fuel while the reactor is operating.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
358, for similar subject matter but wherein there is no treatment of the fuel itself.
- SEE OR SEARCH CLASS:
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 393+ for processes of producing or treating Radioactive metal.
423, Chemistry of Inorganic Compounds, subclasses 3+ for processing or reprocessing, in general, of nuclear reactor fuel.
- 312 By cold traps or hot traps:**
This subclass is indented under subclass 310. Subject matter wherein the impurities are removed from a fluid stream by lowering the temperature thereof to a point which induces precipitation of the impurities.
- 313 By filters, ion exchangers, or absorbers:**
This subclass is indented under subclass 310. Subject matter wherein the impurity is removed from a fluid through the use of (a) a porous mass through which the fluid is passed to separate from it the material held in suspension, or (b) a composition of matter which has the property of replacing the charged specie of the material in solution with ions of the composition.
- (1) Note. This and indented subclasses include filters at the coolant inlet and of, and integral with, the fuel assembly.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
253, for the collection of fission products used in the detection of fuel element flaws.
- 314 Gas filters (e.g., adsorbers):**
This subclass is indented under subclass 313. Subject matter wherein the material to be removed is in the gaseous or vapor state.
- SEE OR SEARCH CLASS:
55, Gas Separation, digest 9 for radioactive filters.
- 315 Electrostatic or magnetic filters:**
This subclass is indented under subclass 313. Subject matter wherein the removal is accomplished by an electrostatic or magnetic field.
- 316 By pressurized fluid (i.e., blowdown):**
This subclass is indented under subclass 310. Subject matter wherein the impurities are flushed from the surface of a reactor component by a fluid driven by a fluid pressure differential.
- (1) Note. Subject matter of this subclass type includes, for example, the removal of corrosion products from a heat exchanger by a pressurized fluid.
- SEE OR SEARCH CLASS:
122, Liquid Heaters and Vaporizers, subclass 381 for blowdown systems in general.
- 317 COMBINED:**
This subclass is indented under the class definition. Subject matter in combination with structures or processes not provided for in this class, per se.
- (1) Note. The combination of a reactor with a heat exchanger, pump, or turbine is provided for elsewhere in this class, see subclasses 179, 211, 378, 391, and 402.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
340+, for reactor structures with testing or irradiation facilities.

- 347+, for typical nuclear reactor power plant structure which may include a turbine.
- 318 With propulsion means:**
This subclass is indented under subclass 317. Subject matter including a nuclear fission reactor combined with a device to move the combined structure.
- SEE OR SEARCH CLASS:
60, Power Plants, subclass 203.1 for propulsion systems involving radiant energy.
- 319 Gaseous core:**
This subclass is indented under subclass 318. Subject matter wherein the nuclear reactor has its fissionable portion in the gas or vapor state or dispersed in a gas or vapor.
- 320 With direct conversion means:**
This subclass is indented under subclass 317. Subject matter wherein the nuclear reaction produces energy, a portion of which energy is transformed into electrical output by a one-step process or apparatus for accomplishing such one-step process.
- SEE OR SEARCH CLASS:
136, Batteries: Thermoelectric and Photoelectric, subclasses 200+ for thermoelectric systems, per se; and subclass 202 for the combination with radioactive decay heat source.
- 321 Thermionic:**
This subclass is indented under subclass 320. Subject matter wherein the one-step includes the heating of a material by the products of the nuclear reaction which material emits electrons or ions due to the high temperature induced therein.
- 322 For storing excess energy:**
This subclass is indented under subclass 317. Subject matter wherein the energy produced by the nuclear reaction is converted to a storable form for later utilization.
- 323 With chemical reaction:**
This subclass is indented under subclass 317. Subject matter wherein the energy of a nuclear reaction is employed to aid a chemical reaction.
- 324 To produce a combustible fuel:**
This subclass is indented under subclass 323. Subject matter wherein a product of the chemical reaction can be burned to produce energy.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
275, for similar subject matter wherein underground hydrocarbons are converted in situ to a combustible fuel.
- 325 Cracking of hydrocarbons:**
This subclass is indented under subclass 324. Subject matter wherein the chemical reaction includes the breaking of hydrogen carbon molecular linkages.
- 326 With laser:**
This subclass is indented under subclass 317. Subject matter wherein the structure or process to be combined with is a source of coherent electromagnetic radiation.
- SEE OR SEARCH CLASS:
372, Coherent Light Generators, appropriate subclasses for lasers, per se.
- 327 CONTROL COMPONENT FOR A FISSION REACTOR:**
This subclass is indented under the class definition. Subject matter comprising a reactor control element.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
207, for a control component in combination with means to move the component to control the reactor.
458+, for moderator structure which is not usable to control the reactor.
- SEE OR SEARCH CLASS:
501, Compositions: Ceramic, appropriate subclasses for ceramic compositions useful as a nuclear reactor component or fuel element material.
- 328 Liquid control component:**
This subclass is indented under subclass 327. Subject matter wherein the reactivity affecting material is in a liquid state.

- 329 With vaporization:**
This subclass is indented under subclass 328. Subject matter wherein the liquid is vaporized to adjust the amount of reactivity affecting material that is within the reactor core region.
- (1) Note. Subject matter of this subclass includes, for example, the use of a heat pipe for varying the amount of reactivity affecting material in the reactor.
- 330 Liquid metal control component:**
This subclass is indented under subclass 328. Subject matter wherein the liquid is a fused or molten metal.
- 331 Gaseous control component:**
This subclass is indented under subclass 327. Subject matter wherein the reactivity affecting material is in a gaseous state.
- 332 Telescopic control devices:**
This subclass is indented under subclass 327. Subject matter wherein the reactivity affecting material is in the form of a plurality of elements adapted to slide or move one within the other as in the manner of a telescope.
- 333 Wherein concentration of the reactivity affecting material varies radially or axially of the control element:**
This subclass is indented under subclass 327. Subject matter wherein the control element is comprised of reactivity affecting material and some other material and the relative amounts of each material varies radially and/or axially along the length of the control element.
- 334 By utilizing a follower:**
This subclass is indented under subclass 333. Subject matter wherein the axial variation in the amount of reactivity affecting material is effected by axially joining an auxiliary control element (follower) having one reactivity effect to a primary control element having a different reactivity effect.
- 335 Flexible control element:**
This subclass is indented under subclass 327. Subject matter wherein the control component is in the form of a nonrigid or nonself-supporting element (e.g., a cable or a plurality of short elements joined one to the other with flexible or pivotal couplings).
- 336 Fuse actuated devices:**
This subclass is indented under subclass 327. Subject matter wherein the control component is moveable with respect to the reactor core and the means for affecting movement of the control component is actuated by or is responsive to, an abnormal reactor operating condition (e.g., abnormal increase in temperature or abnormal increase in neutron flux).
- (1) Note. The abnormal increase in temperature or neutron flux may cause the melting of a solder plug which will then allow the control component to move relative to the reactor core into a position which will cause a decrease in the reactivity of the reactor core.
- 337 Particulate type:**
This subclass is indented under subclass 336. Subject matter wherein the control component is comprised of a mass of separate individual elements which are released for movement with respect to the reactor core when the fuse is actuated.
- 338 Particulate type (e.g., balls):**
This subclass is indented under subclass 327. Subject matter wherein the control component comprises a mass of separate individual elements of reactivity affecting material.
- 339 Nonconventional control material:**
This subclass is indented under subclass 327. Subject matter wherein the reactivity affecting material is defined in terms of its composition or elemental constituents and in other than one of the conventional control material, i.e., boron or cadmium.
- 340 REACTOR STRUCTURES WITH TESTING OR IRRADIATION FACILITIES:**
This subclass is indented under the class definition. Subject matter comprising the combination of two or more of the following: moderator structure, fuel structure, coolant structure, fuel support structure along with structure designed to facilitate or enhance the capability of the reactor structure for the testing or irradiation of materials.

341 With material holder or support positioned outside the radiation source:

This subclass is indented under subclass 340. Subject matter wherein the target holder or support is positioned or caused to be positioned outside or adjacent to the radiation source.

342 With provision for insertion of material to be irradiated into the radiation means:

This subclass is indented under subclass 340. Subject matter wherein the reactor structure is designed to allow insertion of the material to be irradiated.

343 Flux trap reactor structures:

This subclass is indented under subclass 342. Subject matter wherein a nuclear fission reactor* specially constructed so as to provide an internal fuel* free region in which the target can be inserted, the fuel free region having a high thermal neutron flux*.

- (1) Note. The fuel free region will constitute a region or island of internal reflector/moderator.
- (2) Note. Flux trap reactors utilized for testing of reactor components is proper subject matter for this subclass.

344 By fluid pressure:

This subclass is indented under subclass 342. Subject matter wherein the material holder is conveyed into and through the radiation means by a fluid.

345 Wherein the fluid is a liquid:

This subclass is indented under subclass 344. Subject matter wherein the transporting fluid is a liquid.

346 EPI-THERMAL REACTOR STRUCTURES (E.G., INTERMEDIATE NEUTRON SPECTRUM):

This subclass is indented under the class definition. Subject matter comprising a nuclear fission reactor having some moderating material and wherein the neutrons which induce the splitting of nuclei, i.e., fission, have velocities in excess of thermal velocities, 2200 meters per second.

347 REACTOR STRUCTURES:

This subclass is indented under the class definition. Subject matter comprising the combination of two or more of the following structural elements: moderator structure, fuel structure, coolant structure (including primary coolant, per se), or fuel support structure.

- (1) Note. Subject matter of this subclass type includes, for example, thermal reactors, i.e., reactors which contain moderating material which, though not necessarily disclosed, reduces the energy of the neutrons to thermal energy, e.g., 2200 meters per second or 0.03 ev.
- (2) Note. If a reactor is generically recited but is disclosed in the preferred embodiment as a type of reactor specifically provided for in the preceding subclasses, the original copy is placed in the appropriate subclass and a cross-reference copy may be placed in this subclass or in a subclass indented hereunder.
- (3) Note. The coolant structure must be other than such structure built into the fuel structure. For such structures, see subclasses 424 and 439.
- (4) Note. The fuel support structure of this subclass type is other than the support structure for fuel components, per se, as provided for, for example, in subclass 437.
- (5) Note. Subject matter of this subclass type may include subcritical or neutrons amplifying reactor structures.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 171+, for breeder reactors.
- 340, for reactor structures with testing or irradiation facilities.
- 346, for epi-thermal reactors.
- 423, for the moderator enclosed together with the fuel.
- 458+, for moderator structure, per se.
- 904+, for specified materials used as moderator and coolant.

SEE OR SEARCH CLASS:

165, Heat Exchange, subclasses 81+ for heat exchangers including expansion and contraction relieving or absorbing means.

348 Fast thermal composite core:

This subclass is indented under subclass 347. Subject matter wherein the reactor core is comprised of at least two regions, one region operating with fast neutrons and the other region operating with neutrons at thermal energies, i.e., about 0.025 ev.

349 Flux flattening:

This subclass is indented under subclass 347. Subject matter for providing a flatter flux profile across the reactor core.

350 Moderator component varies in its effective density or materials:

This subclass is indented under subclass 347. Subject matter wherein (a) the number of atoms of moderator component per unit volume varies in space, or (b) the nature of the composition of the moderator varies in space so as to display a different moderating effect in one zone of the reactor core area relative to that displayed in another zone.

- (1) Note. The normal change in coolant density as is found along the length of a fuel assembly in a boiling water reactor is not proper for placement in this subclass. Boiling water reactors are in subclasses 370+.

351 Spaced internal reflectors or moderators:

This subclass is indented under subclass 350. Subject matter wherein reflector* or moderator* material is placed inside the reactor core at spaced intervals occupied normally by fuel assemblies or other internal reactor core structure.

352 Orifice or fluid control at inlet or outlet or coolant channels:

This subclass is indented under subclass 347. Subject matter wherein means are provided which alter the amount of coolant* which is (a) flowing into the coolant channel, or (b) flowing out of the coolant channel.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 175, for similar subject matter involving a breeder or converter reactor structure.
243, where the orifice is at the inlet or outlet of a control element.
246, wherein the orifice functions as a flow meter.

353 With particular control rod guide structure:

This subclass is indented under subclass 347. Subject matter wherein the reactor is controlled by use of a control rod* and structure is provided for guiding the control rod during movement thereof, said structure being other than the normal in-core control rod guide tube structure.

354 Fuel material in contact with and supported by fluid:

This subclass is indented under subclass 347. Subject matter wherein the fuel material is in contact with a fluid and at some point in the reactor, or at some time during the reaction, the fuel is also supported by the fluid.

355 Fluidized beds:

This subclass is indented under subclass 354. Subject matter wherein the fuel material is in the form of particulate bodies, a plurality of which are grouped together to form a bed and wherein a fluid flows through the bed of fuel bodies with sufficient force to expand the bed of bodies against any force, e.g., gravity.

356 Fuel dispersed in liquid moderator, solution, etc.:

This subclass is indented under subclass 354. Subject matter wherein the moderator is in liquid form and the fuel is dissolved in, or a particulate form of the fuel is homogeneously distributed throughout the liquid moderator to form a solution, colloid, or slurry.

357 Vapor forming, separating, or manipulating:

This subclass is indented under subclass 356. Subject matter wherein steam or vapor is (a) formed from the liquid moderator at least in part during the course of the reaction, (b) separated as steam or vapor from the liquid moderator, or (c) wherein such steam or vapor is

handled in some way internally or externally of the reactor.

- (1) Note. For other boiling liquid reactors, see subclasses 370+.

358 With particular in situ reconstitution or modification of fuel moderator material:

This subclass is indented under subclass 356. Subject matter wherein the fuel moderator component is reconstituted or modified during the operation of the reactor by the addition or removal of material other than a gas or vapor.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 311, for similar subject matter but wherein the material is treated.

359 Fuel in molten state or in molten vehicle:

This subclass is indented under subclass 354. Subject matter wherein either the fuel or its carrier is in a fused or melted state.

- (1) Note. The fuel may be a liquefied metal, alloy, or compound or one of these dispersed (in particulate form) in a liquefied carrier metal alloy, salt, or other compound.

360 Fuel in form of fused salt:

This subclass is indented under subclass 359. Subject matter wherein the molten fuel or molten carrier is a salt.

361 Circulating fluid within reactor:

This subclass is indented under subclass 347. Subject matter wherein one of the reactor components is a fluid and is under sufficient pressure as to flow into or within the reactor during its operation.

- (1) Note. A patent is placed in this and indented subclasses even if it is not explicit in the claim that a fluid is circulating or flowing if by disclosure the fluid must be or is intended to flow or to circulate.
- (2) Note. In the subject matter of this subclass type the flow or circulation may be intermittent or pulsed.

- (3) Note. A patent is not placed in this and indented subclasses where there is no flow or circulation but there is a static pressure acting on a fluid.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 354+, for circulating fluids containing the fuel.

362 Fuel assembly supports:

This subclass is indented under subclass 361. Subject matter wherein structure is provided for supporting or maintaining the fuel assemblies in their desired positions within the nuclear reactor.

363 Suspended fuel assembly:

This subclass is indented under subclass 362. Subject matter comprising means for supporting fuel assemblies by their upper ends from the top of the reactor, e.g., or by being attached to the closure plug.

364 Fuel assembly holddown or locking means:

This subclass is indented under subclass 362. Subject matter wherein means are provided for maintaining the fuel assembly in its desired position within the reactor against the force of the coolant.

365 Hydraulic or pneumatic:

This subclass is indented under subclass 364. Subject matter wherein a fuel assembly is positioned in the coolant channel and the pressure of the coolant itself is utilized to help maintain the fuel assembly in its desired position in the coolant channel.

366 Plural fluids or a fluid in plural phases circulating within reactor (e.g., pressure tube reactor):

This subclass is indented under subclass 361. Subject matter involving the circulation within a reactor (e.g., pressure tube reactor) of at least two fluid streams which may differ from each other in chemical composition or physical state, e.g., water and steam, water and molten metal, or hydrocarbon.

- (1) Note. For a pressure tube reactor to issue in this or indented subclasses, a first fluid must be circulating through the

pressure tubes with a second fluid being present or circulating outside of the tube through which the first fluid circulates.

- (2) Note. For single fluid pressure tube reactors, search this class (376), subclass 401.

367 In heat pipe means:

This subclass is indented under subclass 366. Subject matter wherein the fluid in plural phases flows in a conduit comprised of two zones, one for transport of the fluid in the liquid state and the other for transport of the fluid in the gaseous state.

368 Including chemically distinct gas:

This subclass is indented under subclass 366. Subject matter wherein one fluid is a gas which is chemically different from other fluids present, e.g., water and helium.

- (1) Note. The term "gas" includes a liquid or solid in the vapor state.

369 With formation, separation, or manipulation of a second gas:

This subclass is indented under subclass 368. Subject matter wherein a second gaseous component is present in the reactor as either steam or vapor and is (a) formed during the course of the reaction, (b) separated from another fluid present, or (c) handled in some way internally or externally of the reactor.

370 With formation, separation, or manipulation of a vapor (e.g., boiling water reactor (bwr) type):

This subclass is indented under subclass 366. Subject matter wherein one of the fluids is steam or vapor which is (a) formed at least in part during course of reaction, (b) separated as steam or vapor from another fluid, or (c) handled as such in some way internally or externally of the reactor.

371 With vapor-liquid separating means:

This subclass is indented under subclass 370. Subject matter having structure for separating or removing the vapor from the liquid.

372 With jet pump:

This subclass is indented under subclass 370. Subject matter wherein at least one of the fluids is caused to circulate with the aid of a jet pump.

SEE OR SEARCH THIS CLASS, SUBCLASS:

392, and 407, for other combinations having jet pumps.

SEE OR SEARCH CLASS:

417, Pumps, subclasses 151+ for jet pumps, per se.

373 Having specified fluid flow path or pattern within reactor core:

This subclass is indented under subclass 370. Subject matter wherein the coolant is made to traverse a specified or predetermined route or channel within the reactor core or the route taken is such as to place the coolant into a pattern or network which serves to exert a particular effect upon the reactor or reaction.

- (1) Note. The recitation of a coolant flowing or circulating through the reactor core is not by itself enough to place a patent in this or indented subclasses.

374 Plural separate coolant loops through reactor core:

This subclass is indented under subclass 373. Subject matter wherein coolant is caused to traverse the reactor core through separate and independent routes.

375 With plural, coolant passes through reactor core:

This subclass is indented under subclass 373. Subject matter wherein the coolant is caused to traverse the reactor core a plurality of times prior to its being sent to a heat exchanger or other utilization means.

376 Re-entrant type:

This subclass is indented under subclass 375. Subject matter wherein the plural coolant passes, the coolant flows first along one flow path in a fuel element structure in one direction and then flow through a different flow path in the same fuel element structure in the reverse direction.

- (1) Note. The flow, for example, may first be along the inner surface of the outer wall of the fuel assembly and then reverse its direction and flow back through a center portion of the fuel assembly.
- 377 With particular flow directing or diverting means (e.g., flow baffle):**
This subclass is indented under subclass 373. Subject matter wherein structure is provided solely for the specific purposes of altering the direction of coolant flow.
- 378 Vapor manipulated or used exterior of reactor core:**
This subclass is indented under subclass 370. Subject matter wherein the steam or vapor has energy (e.g., thermal or kinetic) added to or removed therefrom (e.g., by a heat exchanger, pump, or turbine) exterior of the reactor core.
- 379 With flow control of fluid within reactor:**
This subclass is indented under subclass 378. Subject matter wherein the manipulation or utilization of the vapor exteriorly of the reactor effects some control of (a) the flow of the fluids within the reactor core, or (b) the flow of the fluids to an external component.
- 380 Nonaqueous vapor:**
This subclass is indented under subclass 370. Subject matter wherein one of the fluids is non-aqueous.
- 381 Pebble bed reactor:**
This subclass is indented under subclass 361. Subject matter wherein the fuel material is in the form of generally spherical elements, a plurality of which are held together in a container.
- 382 Having core of separate pebble containers:**
This subclass is indented under subclass 381. Subject matter wherein the fuel elements are in a plurality of separate containers which are arranged together to form the active region of the core.
- 383 Fluid is a gas:**
This subclass is indented under subclass 361. Subject matter wherein the only fluid being circulated or otherwise flowing within the reactor is in a gaseous state.
- (1) Note. Patents are placed into this and indented subclasses even though the gas is capable of existing normally in a non-gaseous phase provided it is maintained in the reactor without permitting any substantial quantity of it to revert to the nongaseous phase.
- (2) Note. This subclass is inclusive of gas having entrained solids.
- 384 Wherein the gas is steam:**
This subclass is indented under subclass 383. Subject matter wherein the fluid is the vapor phase of water.
- 385 Having specified flow path or pattern within reactor core:**
This subclass is indented under subclass 383. Subject matter wherein the coolant is made to traverse a specified or predetermined route or channel within the reactor core or the route taken is such as to place the coolant into a pattern or network which serves to exert a particular effect upon the reactor or reaction.
- (1) Note. The recitation of a coolant flowing or circulating through the reactor core is not by itself enough to place a patent in this or indented subclasses.
- 386 Plural separate loops:**
This subclass is indented under subclass 385. Subject matter wherein coolant is caused to traverse the reactor core through separate and independent routes.
- 387 Plural passes through core:**
This subclass is indented under subclass 385. Subject matter wherein the coolant is caused to traverse the reactor core a plurality of times prior to its being sent to a heat exchanger or other utilization means.
- 388 Re-entrant type:**
This subclass is indented under subclass 387. Subject matter wherein in the plural coolant passes, the coolant flows first along one flow path in a fuel element structure in one direction and then flows through a different flow path in the same fuel element structure in the reverse direction.

- (1) Note. The flow, for example, may first be along the inner surface of the outer wall of the fuel assembly and then reverse its direction and flow back through a center portion of the fuel assembly.
- 389 With particular flow directing or diverting means (e.g., flow baffle):**
This subclass is indented under subclass 385. Subject matter wherein structure is provided solely for the specific purpose of altering the direction of coolant flow.
- 390 With core bypass means (e.g., passage along core barrel or through shield structure):**
This subclass is indented under subclass 389. Subject matter wherein the flow path or pattern of the altered coolant flow includes a path which bypasses the fuel assemblies in the core.
- 391 Manipulated or used exterior of the reactor core:**
This subclass is indented under subclass 383. Subject matter wherein the fluid circulating within the reactor core area is a coolant which has energy (e.g., thermal or kinetic) added to or removed therefrom (e.g., by a heat exchanger, pump, or turbine) exterior of the reactor core.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
210, wherein the manipulation involves modification of coolant flow to control the reactor.
- 392 With jet pump:**
This subclass is indented under subclass 391. Subject matter wherein the coolant is caused to circulate with the aid of a jet pump.
- SEE OR SEARCH CLASS:
417, Pumps, subclass 151 for jet pumps, per se.
- 393 With coaxial flow:**
This subclass is indented under subclass 391. Subject matter wherein the coolant exterior of the core is caused to flow through a concentric pipe arrangement such that the coolant will flow in one direction through the inner pipe and (generally) in the opposite direction through the annulus between the inner and outer pipes.
- 394 With single structure component containment (e.g., pod arrangement):**
This subclass is indented under subclass 391. Subject matter wherein components of the nuclear reactor system are placed within bores of monolithic structure.
- 395 Having specified fluid flow path or pattern within reactor core:**
This subclass is indented under subclass 361. Subject matter wherein the coolant is made to traverse a specified or predetermined route or channel within the reactor core or the route taken is such as to place the coolant into a pattern or network which serves to exert a particular effect upon the reactor or reaction.
- (1) Note. The recitation of a coolant flowing or circulating through the reactor core is not itself enough to place a patent in this or indented subclasses.
- 396 Plural separate coolant loops through reactor core:**
This subclass is indented under subclass 395. Subject matter wherein the coolant is caused to traverse the reactor core through separate and independent routes.
- (1) Note. The coolant loops can be joined to a common conduit outside of the reactor.
- 397 Plural passes:**
This subclass is indented under subclass 395. Subject matter wherein the coolant is caused to traverse the reactor core a plurality of times prior to its being sent to a heat exchanger or other utilization means.
- 398 Re-entrant type:**
This subclass is indented under subclass 397. Subject matter wherein the plural coolant passes, the coolant flows first along one flow path in a fuel element structure in one direction and then flows through a different flow path in the same fuel element structure in the reverse direction.
- (1) Note. The flow, for example, may first be along the inner surface of the outer wall of the fuel assembly and then

- reverses its direction and flow back through a center portion of the fuel assembly.
- 399 With particular flow directing or diverting means (e.g., flow baffle):**
This subclass is indented under subclass 395. Subject matter wherein structure is provided solely for the specific purpose of altering the direction of coolant flow.
- 400 With core bypass means (e.g., passage along core barrel or through shield structure):**
This subclass is indented under subclass 399. Subject matter wherein the flow path or pattern of the altered coolant flow includes a path which bypasses the fuel assemblies in the core.
- 401 One-fluid-type pressure tube reactor:**
This subclass is indented under subclass 395. Subject matter wherein the flow channels in the reactor are formed by a plurality of spaced tubes or conduits, the interiors of which are each at pressure substantially higher than the pressure of the adjacent medium.
- 402 Manipulated or used exterior of reactor core:**
This subclass is indented under subclass 361. Subject matter wherein the fluid circulating within the reactor core area is a coolant which has energy (e.g., thermal or kinetic) added to or removed therefrom (e.g., by a heat exchanger, pump, or turbine) exterior of the reactor core.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
210, wherein the manipulation involves modification of coolant flow to control the reactor.
369+, 378+, 380, and 391+, for similarly handling gases for use exterior of reactor core.
- SEE OR SEARCH CLASS:
165, Heat Exchange, appropriate sub-classes for cooling towers.
261, Gas and Liquid Contact Apparatus, appropriate subclasses for cooling towers.
- 403 Including tank, pool, or reservoir (e.g., swimming pool):**
This subclass is indented under subclass 402. Subject matter wherein a relatively large mass of fluid is maintained within a vessel which serves as a tank, pool, or reservoir.
- (1) Note. Tank-type reactors, i.e., wherein the reactor core, pumps, and heat exchanger are all immersed in the same fluid, are proper subject matter for this and indented subclasses.
- 404 Having reactor core and heat exchanger or pump therein:**
This subclass is indented under subclass 403. Subject matter having one vessel in which is situated the reactor core, primary heat exchangers, or pump, all of which are immersed in the liquid coolant.
- 405 With particular heat exchanger structure:**
This subclass is indented under subclass 404. Subject matter wherein the heat exchanger is more than nominally disclosed.
- (1) Note. The mere disclosure of a fluid flowing through a heat exchanger is insufficient basis for classification in this subclass.
- 406 Compact or integral (e.g., heat exchanger, core, pumps in same vessel):**
This subclass is indented under subclass 402. Subject matter wherein the components of the reactor circuit, e.g., heat exchanger, core, pumps, are all contained within a common vessel.
- (1) Note. The vessel may be partitioned with the reactor core in one part, heat exchanger in another and separate part, etc.
- 407 With jet pumps:**
This subclass is indented under subclass 402. Subject matter wherein the coolant is caused to circulate with the aid of a jet pump.

408 With means or structure to flash coolant into vapor:

This subclass is indented under subclass 402. Subject matter wherein the coolant is caused to abruptly change to the vapor phase, e.g., by sudden pressure reduction.

409 FUEL COMPONENT STRUCTURE:

This subclass is indented under the class definition. Subject matter comprising an integral structure the constituent material of which includes, at least in part, a nuclear fuel*.

- (1) Note. A patent to be placed as an original into this and indented subclasses may be associated with another reactor component when the other component is so associated with the fuel component that the plural components are treated or handled as one, as when within the fuel component structure there is included some other component structure such as a coolant, moderator, insulator, thermocouple, or other structure.
- (2) Note. For processes of fabricating or manufacturing reactor fuel component, search appropriate manufacturing class.
- (3) Note. Patents that claim some particular handling of the fuel component are placed as originals in the appropriate subclasses in this class and may be crossed to this and indented subclasses.
- (4) Note. The fuel material itself may be solid, liquid, or gaseous.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 261+, for patents that claim some particular handling of the fuel component.
- 347, for patents claiming a fuel separately associated in some particular manner with another reactor component, including a fluid component.

SEE OR SEARCH CLASS:

- 29, Metal Working, subclasses 400.1+ for methods of assembly and disassembly of fuel elements, and subclass 723 for apparatus for disassembly of fuel elements. See subclass 906 for a cross-

reference art collection of documents reflecting to nuclear device making.

- 148, Metal Treatment, subclass 401 for heat-treated metal stock which may be useful in the production of fuel elements; and subclass 132 for heat-treated actinide metals or alloys.
- 252, Compositions, subclasses 625+ for compositions not otherwise provided for that may be used as fuels or in fabricating fuel elements.
- 420, Alloys or Metallic Compositions, particularly subclasses 1+.
- 423, Chemistry of Inorganic Compounds, subclasses 249+ for inorganic compounds of the actinide series elements which may be useful as fuel components.
- 427, Coating Processes, subclass 6 for processes of coating nuclear fuel particles or elements.
- 501, Compositions: Ceramic, appropriate subclasses for ceramic compositions useful as a nuclear reactor component or fuel element material.

410 With means to prevent thinning of the cladding (e.g., amoeba effect):

This subclass is indented under subclass 409. Subject matter wherein the fuel component structure contains a material which serves to inhibit the thinning of the fuel covering (i.e., cladding) by diffusion during reactor operation (i.e., "amoeba effect").

411 Spherical particles:

This subclass is indented under subclass 409. Subject matter wherein the fuel is in a spherically shaped form.

412 Encased with nonfuel component:

This subclass is indented under subclass 409. Subject matter wherein a material (e.g., fluid) or structural element having a reactor function different from that of the fuel (e.g., moderator, heat insulator, coolant) is encased, enclosed, or sealed together with the fuel material within a single container (i.e., a "cladding").

413 With internal pressurizer:

This subclass is indented under subclass 412. Subject matter wherein a means is provided within the container (i.e., cladding) for maintaining the pressure within the fuel component

substantially constant during or throughout its operating life, e.g., by releasing a gas subsequent to fabrication of the fuel component.

414 Coated, preformed, or impregnated layer or part or adhesively bonded layers or parts:

This subclass is indented under subclass 412. Subject matter including a preformed layer or part having a coating thereon or an impregnate therein, or plural preformed layers bonded together.

- (1) Note. The bonding may be either autogenous or by means of a bonding agent.
- (2) Note. When the preform is porous, the coating or impregnating material may be located or concentrated upon the surface or may penetrate substantially the entire layer or part.

415 Lubricating layer:

This subclass is indented under subclass 414. Subject matter wherein the coating or impregnate comprises a lubricant.

416 Multiple or composite cladding-type layers:

This subclass is indented under subclass 414. Subject matter wherein the cladding itself is comprised of a plurality of layers.

417 Including getter layer or barrier layer:

This subclass is indented under subclass 416. Subject matter wherein at least one of the cladding layers acts or functions as an absorber or barrier with respect to the transport of fuel or nuclear reaction products between the fuel and an outer cladding layer.

418 Getter, fission product retainer or filter:

This subclass is indented under subclass 412. Subject matter wherein the nonfuel component functions as an absorber or complete or selective barrier with respect to the transport of fuel or nuclear reaction products.

419 Burnable poison:

This subclass is indented under subclass 412. Subject matter wherein the nonfuel component is a burnable poison*.

SEE OR SEARCH THIS CLASS, SUBCLASS:

447, for a burnable poison in fuel pack or bundle but not encased with the fuel itself.

420 Interpellet spacing or positioning means:

This subclass is indented under subclass 412. Subject matter wherein the encased material is a nonfuel material which is positioned between two separate fuel bodies, i.e., pellets.

421 Homogeneously intermixed:

This subclass is indented under subclass 412. Subject matter wherein the encased material is intermixed, more or less, homogeneously throughout the fuel material.

- (1) Note. The subject matter of this subclass type includes fuel dissolved or dispersed in a fluid moderator; the fuel and encased material may be a granulated mixture or in the form of a solid solution, etc.

SEE OR SEARCH CLASS:

252, Compositions, subclasses 625+ for radioactive compositions which may include the nuclear fuel material.

501, Compositions: Ceramic, appropriate subclasses for ceramic compositions useful as a nuclear reactor component or fuel element material.

422 Alloyed fuel:

This subclass is indented under subclass 421. Subject matter wherein the fuel or a part thereof is metallic which is alloyed with the encased material which is also metallic.

423 Moderator or reflector:

This subclass is indented under subclass 412. Subject matter wherein the encased material is a neutron moderator or reflector material.

424 Coolant or heat exchange material:

This subclass is indented under subclass 412. Subject matter wherein the encased material is a coolant* or heat exchange material.

- 425 Heat insulating material:**
This subclass is indented under subclass 412. Subject matter wherein the encased material is not transmissive of thermal energy, i.e., is a heat insulating material.
- 426 Plural fuel segments or elements:**
This subclass is indented under subclass 409. Subject matter wherein the fuel component structure is comprised of either (a) a plurality of fuel segments which are sealed, enclosed, or contained within a single container, or (b) a plurality of elements assembled together with each element itself consisting of an enclosed, sealed, or contained integral mass of fuel or a plurality of fuel segments.
- 427 In solid moderator block:**
This subclass is indented under subclass 426. Subject matter wherein the structure for attenuating neutron energy takes the form of a given volume, usually a parallelepiped, which contains nuclear fuel either as an admixture or discrete bodies, positioned therein.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
421, for fuel homogeneously mixed with moderator.
423, for fuel encased with moderator.
- 428 Wherein the fissile content varies radially or axially within the same container (e.g., plural fuel layers):**
This subclass is indented under subclass 426. Subject matter wherein the plural segments are so constituted and arranged within a container that the fissile* content of the container varies radially or axially.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
435, for plural fuel elements in a pack or bundle, the fissile content of which varies radially or axially.
- 429 Complementary segments within same container:**
This subclass is indented under subclass 426. Subject matter wherein a plurality of fuel segments are included within a container with the segments being constructed or shaped to complement or mate with each other.
- (1) Note. The mere use of a flat surface on the segments (which would allow stacking) is not sufficient for placement in this subclass.
- 430 Spherically shaped segments within same container:**
This subclass is indented under subclass 426. Subject matter wherein the fuel segments are approximately spherically shaped pellets and are randomly positioned within a container.
- 431 Concentric cylindrical elements:**
This subclass is indented under subclass 426. Subject matter comprising at least two tubular fuel elements one of which is nested inside the other.
- 432 Plate-type fuel elements:**
This subclass is indented under subclass 426. Subject matter wherein the fuel elements are in the form of plates which are at least in part, spaced from and substantially parallel to each other.
- 433 Stacked (e.g., candu type reactor fuel components):**
This subclass is indented under subclass 426. Subject matter wherein plural fuel segments, elements, or components are assembled in a linear normally vertically relationship, e.g., one above the other.
- 434 In pack or bundle:**
This subclass is indented under subclass 426. Subject matter wherein the plural segments or elements are held together in a pack or bundle-like relationship relative to each other or to a container or to other structure, by a spacing, supporting, or securing means.
- 435 Wherein the fissile content varies radially or axially across the pack or bundle:**
This subclass is indented under subclass 434. Subject matter wherein the amount or concentration of fissile* material varies radially and/or axially across the pack or bundle.
- (1) Note. The variation of fissile isotope includes the use of one fissile isotope, e.g., plutonium 239 in some fuel members, and another fissile isotope, e.g., Uranium 235, in other fuel members.

436 Wire-wrapped fuel elements:

This subclass is indented under subclass 434. Subject matter wherein the spacing means comprises a wire wrapped around a fuel element.

- (1) Note. The wire may be wrapped in a helical fashion.

437 Having the fuel element ends positioned on or attached to rails:

This subclass is indented under subclass 434. Subject matter wherein the fuel elements have at least one of their ends attached to or positioned on a bar (rail).

- (1) Note. The pack or bundle will normally have a plurality of such rails with the rails being generally parallel to one another.
- (2) Note. The rails are not to be considered grids.

438 Including grid:

This subclass is indented under subclass 434. Subject matter wherein a multiaperture structure holds or maintains the plural fuel segments or elements in a spaced array.

- (1) Note. The multiaperture structure may be a grating or egg cratelike structure.

SEE OR SEARCH CLASS:

- 52, Static Structures (e.g., Buildings), subclass 664, 666, and 668 for similar grid structures, per se.
- 211, Supports: Racks, subclass 60.1 for similar grid structures, per se.
- 248, Supports, subclass 68.1 for similar grid structures, per se.

439 With coolant flow path deflecting means:

This subclass is indented under subclass 438. Subject matter wherein the grid is provided with structure for the specific purpose of altering (deflecting) the direction of coolant flow.

440 For ends of fuel elements:

This subclass is indented under subclass 438. Subject matter wherein the grid contacts and engages the ends of the fuel elements.

- (1) Note. Subject matter of this subclass type may include tie rod end plates which engage the ends of the fuel elements.

441 With nonintegral fuel element contacting means:

This subclass is indented under subclass 438. Subject matter wherein the grid is provided with a separable component and this component is utilized to contact and maintain the fuel pins in the spaced apart array.

442 With fuel element contacting protuberance or projection:

This subclass is indented under subclass 438. Subject matter wherein the grid comprises walls defining fuel element compartments, at least one wall of which is provided with means extending away from the wall into the compartment to position the fuel element therein.

443 With coolant flow path deflecting means:

This subclass is indented under subclass 434. Subject matter wherein structure is provided for the specific purpose of altering (deflecting) the direction of coolant flow.

444 With coolant flow bypass means:

This subclass is indented under subclass 443. Subject matter wherein structure is provided such that a portion of the coolant does not come into direct contact with the nuclear fuel containing members.

445 With thermal expansion compensating means:

This subclass is indented under subclass 434. Subject matter with means to compensate for changes in dimension of at least a part of the pack or bundle due to thermal expansion.

446 With removable member:

This subclass is indented under subclass 434. Subject matter wherein the pack or bundle includes a member which is removable from the rest of the pack or bundle, e.g., a fuel pin, moderator pin, poison pin, a grid, a sheath, etc.

- 447 Including separate burnable poison or moderator:**
This subclass is indented under subclass 434. Subject matter wherein the pack or bundle contains burnable poison* or moderator which is not encased together with the fuel, that is, the burnable poison or moderator will be in its own separate pin or element, in a grid, in the sheath, etc.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
419, for burnable poison encased with the fuel.
423, for moderator encased with the fuel.
- 448 With means for spacing apart adjacent packs or bundles:**
This subclass is indented under subclass 434. Subject matter wherein the assemblies or bundles contain structure which serves to maintain the outer surfaces of adjacent packs or bundles spaced apart from one another.
- 449 Having provision or structure for insertion of control elements therein:**
This subclass is indented under subclass 434. Subject matter wherein the pack or bundle has provision or structure which allows control elements to be inserted therein.
- 450 With condition sensing or indicating means:**
This subclass is indented under subclass 409. Subject matter wherein the fuel component includes a structure or material for sensing or indicating some condition of the fuel component.
- (1) Note. Sensing structure includes, for example, thermocouples and strain gages; indicating material may include a gas. The conditions sensed or indicated may include the integrity of the cladding, temperature, etc.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
247, for temperature or pressure measurement.
251, for apparatus for or process of detecting, sensing, or monitoring a leaking fuel element.
- 451 Having particular end closure or seal (e.g., weld, plug, cap, etc.):**
This subclass is indented under subclass 409. Subject matter including a particular or specific means for closing the end(s) of a fuel element or component, e.g., weld, cap, etc.
- 452 With indexing means:**
This subclass is indented under subclass 451. Subject matter wherein the fuel element end cap has a particular distinguishing feature or structure associated therewith for discerning its identity among other fuel elements.
- 453 Fuel support or covering provided with fins, projections, prongs, etc.:**
This subclass is indented under subclass 409. Subject matter having means to contain, cover, or support the fuel, which means is provided with internal or external projections, protuberances, prongs, fins, or other similar structure.
- (1) Note. The fins, etc., may serve such diverse functions as spacing members, support, dividers, aligning of or with heat exchange and fluid flow passages, etc.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
436, for wire-wrapped fuel pins in a pack or bundle.
- 454 With external fins, projections, prongs, etc.:**
This subclass is indented under subclass 453. Subject matter wherein the fins, etc., are on the outer surface of the fuel container, support, or covering.
- 455 Hollow, annular, or graduated fuel layers or members (e.g., concentric, helical, etc.):**
This subclass is indented under subclass 409. Subject matter wherein at least the portion containing the fuel material itself is in the form of a sheet or tube which may be arranged or associated with itself concentrically or helically.
- 456 Vented fuel:**
This subclass is indented under subclass 409. Subject matter wherein the fuel component includes a means to release fission products therefrom during normal operation of a nuclear reactor.

457 Nonconventional jacket or can material:
This subclass is indented under subclass 409. Subject matter wherein the fuel is covered or clad by a material other than the conventional cladding materials of Al, Zr, steel, etc.

458 MODERATOR OR REFLECTOR COMPONENT STRUCTURE FOR A FISSION REACTOR:
This subclass is indented under the class definition. Subject matter comprising structure whose proximate function is to attenuate the energy of an incident neutron (moderator) or to alter the trajectory of an incident neutron (reflector) in a nuclear fission reactor.

459 With means for keying or assembling moderator blocks together:
This subclass is indented under subclass 458. Subject matter wherein the material for reducing neutron energy is formed into a given volume, usually a parallelepiped, which is so shaped as to facilitate the interconnection of the given volumes one with another.

460 ROTATING PLUG-TYPE COVER:
This subclass is indented under the class definition. Subject matter comprising a closure for a fission reactor vessel which closure is capable of rotary movement.

461 VESSEL SUPPORTS (E.G., CORE VESSEL-SUPPORTS):
This subclass is indented under the class definition. Subject matter wherein load-bearing means are provided to accommodate the weight of a fission reactor vessel in a fixed position.

462 GRIDS:
This subclass is indented under the class definition. Subject matter wherein a multiaperture structure holds or maintains reactor components in a spaced array.

SEE OR SEARCH CLASS:

- 52, Static Structures (e.g., Buildings), subclass 664, 666, and 668 for similar type grid structures, per se.
- 211, Supports: Racks, subclass 60.1 for similar grid structures.
- 248, Supports, subclass 68.1 for similar grid structures.

463 MISCELLANEOUS:
This subclass is indented under the class definition. Subject matter comprising material not provided for elsewhere.

CROSS-REFERENCE ART COLLECTIONS

900 PARTICULAR MATERIAL OR MATERIAL SHAPES FOR FISSION REACTORS.
This subclass is indented under the class definition. Collections of patents that claim or disclose a specific or particular reactor component by its material make-up (composition, etc.) or when in some particular shape, and not amounting to structure provided for in the main schedule above.

901 Fuel:
This subclass is indented under subclass 900. Subject matter wherein the fuel is defined by its material makeup.

902 With external lubricating or absorbing material:
This subclass is indented under subclass 901. Subject matter wherein the outer surface of the fuel element is provided with a material which facilitates assembly of the fuel elements with their spacing, supporting, or scuring means by reducing the friction on the fuel elements or is provided with an absorber to facilitate handling during refueling.

903 Shapes:
This subclass is indented under subclass 901. Subject matter wherein the fuel is formed into a specific or peculiar shape.

904 Moderator, reflector, or coolant materials:
This subclass is indented under subclass 900. Subject matter wherein a specific moderator or coolant material is claimed or disclosed which goes beyond such normal materials as graphite, Be, H_2O , D_2O , etc.

905 Organic:
This subclass is indented under subclass 904. Subject matter wherein the material is organic.

- 906 Metal:**
This subclass is indented under subclass 904. Subject matter wherein the material is a metal.
- 907 Dissociative coolants:**
This subclass is indented under subclass 904. Subject matter wherein the coolant is a material which dissociates upon heating.
- 908 REACTOR GEOMETRY (OR PART THEREOF) DEFINED IN TERMS OF NUMERICAL VALUES:**
Subject matter involving numerical relationship between various parameters of a nuclear fission reactor.
- 909 MOBILE REACTORS:**
Subject matter involving a nuclear power generating system which is portable.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
318, for nuclear plants which provide propulsion.
406, for nuclear plants which are compact or integral.
- 910 ROTATING REACTORS:**
Subject matter involving a nuclear reactor wherein the core (or at least a portion thereof) revolves or rotates about an axis.
- 911 PLURAL REACTOR SYSTEMS:**
Subject matter involving at least two reactors which are associated together in some manner so as to present an overall single system.
- 912 NUCLEAR REACTOR SYSTEMS SITUATED IN THE OCEAN:**
Subject matter involving a nuclear reactor system which is designed for operation and situation directly in a large body of water.
- 913 ANTIMATTER DEVICES AND METHODS:**
Subject matter involving reactions which produce annihilation radiation.
- 914 NUCLEAR EXPLOSIVES:**
This subclass is indented under the class definition. Collection of patents that claim or disclose an uncontrolled nuclear reaction structure, e.g., a bomb.
- 915 FUSION REACTOR FUELS:**
Subject matter involving fuels (materials, compositions) for use in nuclear fusion reactions.
- 916 METHODS OF MAKING FUSION FUEL TARGETS:**
Subject matter involving methods of manufacturing bodies or elements containing fusion fuel material.
- 917 UTILIZING DIFFERENT FUELS OR FUELS IN DIFFERENT FORMS, IN DIFFERENT REACTOR REGIONS IN RELATION TO AMOUNTS OF HEAT PRODUCED IN SAID REGIONS:**
Subject matter involving the utilization of different fuels or fuels in different forms in relation to amounts of heat produced in the regions.
- 918 ENTIRE REACTOR CORE OF SINGLE INTEGRAL STRUCTURE:**
Subject matter wherein the entire reactor core is comprised of a unitary structure.
- END